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18

USER GUIDE FOR THE EXCHANGE OF MEASURED WAVE DATA

Unesco 1987

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INTRODUCTION

This Guide is intended to assemble in a convenient form the procedures and formats established to facilitate the international exchange of measured wave data. The information contained here is intended to be of assistance to the collector or user of the data and to the computer programmer developing software to prepare or read magnetic tapes containing the data.

Part 1 below contains a discussion of the determining principles of the exchange scheme. An overview of the exchange procedures is presented in Part 2. Part 3 provides detailed information on documentation, formats, parameter codes and the availability of software for wave data exchange.

The procedures and mechanisms for international exchange of wave data which are described here have been developed by the Task Team on Wave Data Management and the Group of Experts on Format Development of the IOC Working Committee on International Oceanographic Data Exchange (WC-IODE). The Committee has given its approval to all of the procedures and formats contained here.

1. DETERMINING PRINCIPLES OF THE EXCHANGE SCHEME

Measured wave data are in many ways a challenge to an exchange scheme. Although simple in concept, the measurement and characterization of a wave field by a few useful parameters is not a simple matter. As a result, there have developed a variety of instruments, techniques and analyses for accomplishing the task. Each instrument and each analysis technique can be used under certain conditions but may have to be avoided in other situations. Instruments based on accelerometers generally will not yield accurate information on long period waves associated with wind-wave groups. Instruments based on submerged pressure devices have a limited response to shorter period wind-waves. Analysis procedures for the data from the two instruments will differ substantially.

These considerations lead to the first fundamental principle in a scheme for the exchange of measured wave data:

> "The user receiving and applying the data to his problem will need to know a great deal about how the data were collected and analyzed."

The importance of documenting these data in the manner described cannot be overstated if a researcher is to utilize the data to its potential.

A further consideration for the exchange scheme emerges when one considers the volume and nature of data collected by some national wave programs. A measured wave observation usually consists of a record of the elevation of the water surface as a function of time at a point or of a related parameter such as the pressure at a point beneath the surface. These raw data are, of course, not the parameters of interest to an engineer designing an offshore platform or of a scientist examining the occurrence of groups of large waves. Clearly, each of these problems will require an analysis of the recorded signal, and these analyses will be different. To further complicate the situation, it is not possible to anticipate all the needs of engineering and science programs for various analyses. It is customary in many cases to keep the original time series for later analyses for other purposes. Thus, the archival data banks contain large volumes of data - in some cases, several hundred to a few thousand computer types. Storage costs are, as a result, quite high, and exchanges can involve large volumes of data.

This leads to two further conclusions regarding the exchange scheme:

> "It is uneconomic and not useful to attempt to store all wave data in one massive data bank, thus duplicating national data banks at great cost."
>
> "The medium for wave data exchange for the present should be computer compatible magnetic tape."

A final consideration is related to the fact that many national wave programs archive a variety of calculated parameters as well as the original time series. These calculated parameters include variables which describe the characteristics of the wave field, such as significant wave height, and variables which can be used to assess the quality of the wave measurement, such as the zero expectation cross-spectra. These parameters are therefore of interest to various groups of users. Therefore, the final principle of the system is:

> "The exchange scheme should provide for those calculated parameters most frequently produced by national wave programs that describe the wave field and can be used to assess the quality of the measurements."

2. SCHEME FOR THE EXCHANGE OF MEASURED WAVE DATA

2.1 PRINCIPLE ELEMENTS OF THE EXCHANGE SCHEME

There are four principle elements of the scheme for the exchange of measured wave data:

(a) The IODE Responsible National Oceanographic Data Centre - Waves (RNODC-WAVES).

(b) The general format for the exchange of oceanographic data on magnetic tape, GF3.

(c) The IODE System of National, Responsible and World Oceanographic Data Centres.

(d) The RNODC-FORMATS.

2.2 THE RNODC-WAVES

The RNODC-WAVES is operated by the Marine Information and Advisory Service of the United Kingdom (MIAS) and is responsible for maintaining and publishing an inventory of the wave data holdings of member states of IOC. The terms of reference of the RNODC are contained here as Annex A. Information for the inventory is gathered using a form developed for the purpose. The form is circulated regularly to national co-ordinators for IODE in IOC Member States and to a list of contact points for the Permanent Internationl Association of Navigation Congress (PIANC). The World Meteorological Organization (WMO) has also urged its Member States through their permanent representatives to contribute inventory information on measured wave data to the RNODC-WAVES. It is therefore expected that the inventory has had sufficient input to hold quite complete information on national wave data holdings.

The inventory form has been carefully designed to include as much information as possible about the instrumentation, how the data were collected and analyzed, the details of the measurement site, and any factors which might affect the use of the data or their applicability to the general area of the measurement site. This is intended to provide the user with the necessary information to determine whether the data would be useful to him for his application. A copy of the inventory form is included here as Annex B.

The inventory, in addition to facilitating the transfer of relevant information about the measurement program, also serves the purpose of identifying to the user the holder of the data. Once he has determined that the data would be useful to him, the user can either approach the holder of the data directly to discuss an exchange, or he can seek assistance from the RNODC-WAVES or from one of the World Data Centres for Oceanography, as discussed below.

It should be recognized that it will not always be necessary to exchange actual wave data to meet the requirements of the user. In many cases, national wave programs prepare summaries of the data or publications. Copies of these publications or summaries may be sufficient for the needs of many users. Information on the availability of summaries and publications is included in the RNODC-WAVES inventory.

2.3 THE USE OF GF3 FOR THE EXCHANGE OF MEASURED WAVE DATA

Once the user and the holder of the data have agreed to an exchange, it is necessary to agree on a magnetic tape format for the particular wave information to be transferred. The GF3 format has been recommended for this purpose, although other mutually agreed arrangements can be made between the two parties, if appropriate.

To help with the exchange in GF3, a number of standard GF3 subsets have been developed to accommodate the more commonly exchanged parameters. These subsets are as follows. More detailed format information is given in Annex C.

(a) Wave Height-Period Subset

(b) Digital Wave Records Subset

(c) Measured Wave Spectra Subset

(d) Directional Spectral Subset.

The "Wave Height-Period Subset" is intended for use in exchanging the parameters most commonly used to describe the height and period of the waves. It provides for such variables as significant or characteristic wave height, peak period of the spectrum, and the Tucker parameters, such as highest crest, lowest trough, and number of zero crossings.

The "Digital Wave Records Subset" is intended for use in exchanging the time history of the surface elevation. This is for users who wish to apply a different analysis technique to the one which was used originally by the program collecting the data. It is expected that all corrections for the transfer functions of the instruments involved will have been applied. Otherwise, it should be made very clear in the accompanying documentation what corrections need to be applied.

The "Measured Wave Spectra Subset" is intended for users interested in receiving the one-dimensional wave spectrum for problems such as response of platforms or ships to the waves. Once again, corrections due to calibrations or instrument transfer functions should be applied to the data prior to the transfer. Otherwise, the required corrections should be detailed in accompanying documentation.

The "Directional Wave Spectral Subset" is for the exchange of the more complex directional data. These data may be instrumental measurements or may have been generated by numerical wave models.

2.4 THE ROLE OF THE NATIONAL AND WORLD DATA CENTRES IN WAVE DATA EXCHANGE

National Oceanographic Data Centres and the World Data Centres play an important role in the international exchange of measured wave data. The role of the World Data Centres is primarily one of coordination and referral. The WDC's may assist users in establishing contact with the RNODC-WAVES or the RNODC-FORMATS as necessary to obtain inventory or GF3 format information. They may also assist users in establishing contact with National Oceanographic Data Centres to acquire the wave data itself. WDC's may also, at their discretion, and where appropriate, undertake to obtain the data on behalf of the user.

The NODC's in most Member States of IOC will carry the major responsibility for the archival and accessioning of the wave data. Once a user need is established, a referral to the NODC holding the data will be effected. By arrangement and on a negotiated cost basis, if necessary, the NODC will provide or arrange for the provision of a GF3 tape with the data or the appropriate publication or wave data summary to the user or the centre acting on behalf of the user.

It is hoped that the measured wave data or the publications and summaries can be provided free of charge. However, it must be realized that in some Member States NODC's may be required to recover the costs of providing the magnetic tape or publication to a user. If there is to be such a charge, it is the responsibility of the NODC to inform the user of the fact that there will be a charge and of the amount prior to the exchange. The user will then make the decision to proceed or not.

2.5 THE RNODC-FORMATS

The RNODC-FORMATS is operated by the Service Hydrographique of the International Council for the Exploration of the Seas (ICES). This RNODC has accepted responsibility for maintaining files of information on the GF3 format and on available software for creating and reading GF3 tapes. Specifically, users can obtain up-to-date specifications for the GF3 standard subsets available for the exchange of measured wave data and on any available software which might assist them in creating or reading the tapes. The Terms of Reference for the RNODC-FORMATS is included as Annex D.

The RNODC-FORMATS will generally have available more recent and complete information than will be available from IOC publications. This is so for two reasons. Firstly, there is an unavoidable time delay associated with producing publications. Secondly, there is not a requirement to publish all of the GF3 formatting information. The RNODC has been established as the mechanism to make this information available.

3. DETAILED INFORMATION ON TECHNICAL ASPECTS OF WAVE DATA EXCHANGE

The previous chapter provided a general overview of the scheme developed by the TC-IODE for the exchange of measured wave data. This chapter provides more detailed information on some of the more technical aspects which users and providers of data will face when trying to effect an exchange.

3.1 MINIMUM NECESSARY DOCUMENTATION TO ACCOMPANY INSTRUMENTAL DATA EXCHANGE

It is recommended that the minimum documentation accompanying exchanges of instrumented wave data should include information on the wave sensing instrument, the location and physical characteristics of the measurement site, the data sampling and recording techniques, the analysis procedures, and the forms in which the data are available. A comprehensive list of the required information is given in Annex E.

It is recognized that a certain amount of the information may be pertinent only to certain types of wave measurements. For example, tidal ranges and the presence of offshore bars would not be necessary for deep ocean stations. Also, certain information in the section on analysis procedures would only apply if a spectral analysis was used.

3.2 STANDARDS FOR THE EXCHANGE OF MEASURED WAVE DATA USING GF3

The following procedures and standards should be adopted and used, unless otherwise agreed between exchanging parties:

(a) Data should usually be processed for all instrumental corrections, including frequency response corrections. If it is not possible to apply a frequency response correction, a comment warning the user that response corrections have not been made must be present in the plain language comments. The comment can be in the tape header if it applies to all files on the tape or in the appropriate file header records.

(b) Data should be exchanged on magnetic tape formatted according to the appropriate standard subset of GF3.

(c) All data values should be expressed in S.I. units, and all times should be expressed in GMT.

(d) All wave data series should include entries in the appropriate GF3 fields for the following:

Country, organization, originator, station identifier, data center station identifier, dates and times of wave recorder installation and removal, dates and times of start and end of usable data, latitude, longitude, positional uncertainty, sea floor depth, number of observations in a file, and the duration of the wave record (e.g. 20 minutes). For the MEASURED WAVE SPECTRA SUBSET, the bandwidth of the analysis, and the number of estimates of spectral density are also required. For the DIGITAL WAVE RECORDS SUBSET, the digitizing frequency is required.

3.3 DEFINITIONS OF WAVE PARAMETERS WHICH CAN BE EXCHANGED IN GF3

The definitions for the wave parameters considered for exchange under the present scheme are given in Annex F.

3.4 DOCUMENTATION TO BE INCLUDED IN PLAIN LANGUAGE COMMENTS ON GF3 TAPES FOR WAVE DATA EXCHANGES

The following documentation, where applicable, must be included as plain language comments at the tape header level or file header level to ensure adequate documentation of the data.

(a) Station

  (1) Purpose of measurement;

  (2) mean tidal range at station;

  (3) approximate maximum currents; and

  (4) a comment on any offshore bars, structures, or obstructions which might affect the measurements.

(b) Instrument

  (1) Type of instrument (e.g. accelerometer buoy, pressure cell);

  (2) name of instrument, manufacturer, and model number;

  (3) digital sampling frequency (if applicable); and

  (4) date and method of calibration, along with a comment on the stability of calibrations.

(c) Data Analysis

  (1) Type of processing performed on data and methods of deriving parameters;

  (2) a description of any corrections or filtering applied to the data; and

(3) any general remarks which would be useful in interpreting the data.

(d) Data Quality

(1) Comment on data quality and report any known errors or uncertainties in the data;

(2) a description of quality control procedures applied to the data; and

(3) any additional items which might have affected the data or have a bearing on its use.

3.5 ADDING OTHER PARAMETERS TO GF3 STANDARD SUBSETS

Users may occasionally or even frequently wish to exchange wave data parameters not provided for in the standard subsets for GF3. If the requirement is only for some additional parameters and does not involve a revision of the heirarchical structure of the data, then it is a straightforward matter to build on the appropriate standard subset.

For demonstration purposes, some parameters will be added to the "Wave Height-Period Subset" given in Annex C. The parameters which will be added are the height and period of the maximum zero upcrossing wave in each wave record.

Since there is one occurrence of height and period for each wave record the parameters will be added at the data cycle level. The tape structure as presented in section 3 of the subset description in Annex C is unchanged. There will be no changes to the series header record. The only changes will be to the Data Cycle Definition Record, the Plain Language Records and to the Data Cycle Records themselves.

For the Data Cycle Definition Record a change will be required to card image 002 of section 4.1 of the Wave Height-Period subset description in Annex C and card images 016 to 019 respectively will be filled in as follows.

```
4 VZMX7XXD   MAX ZERO CROSS HT(M)       I   3 93     0.1     0.0             016
4 FFFF7AAN   Q.C FLAG FOR MAX ZERO HT(M)A   1                                017
4 VTZM7XXD   PERIOD MAX ZR CR WAVE(SEC) I   3 93     0.1     0.0             018
4 FFFF7AAN   Q.C. FLAG FOR ZR CR PER    A   1                                019


            mode
         designator
                                                         scale 2
                        field
                       length          scale 1
                                                   dummy
                                                   value
                                                   code
```

These parameter definition records accomodate the two new parameters and a quality control flag for each. The parameter codes for the maximum zero crossing height and associated period are standard GF3 codes which can be found in the code tables (see section 3.8). The method codes are unspecified. The units are SI units, i.e. metres and seconds respectively. The mode designator "I" and the field length value "3" indicates a three digit integer field. The "scale 1" multiplication and "scale 2" addition factors of 0.1 and 0., respectively, indicate that the number in the data cycle record is to be multiplied by 0.1 and to have 0. added to it. In other words the number can be between 0 and 99.9 metres or seconds.

The dummy value code field is specified as 93 (meaning 999). That is, if a value of the parameter is missing it is to be replaced with 999. This is valid since it is assumed that the heights or periods of wind waves will always be less than 99.9 metres or seconds.

There are two final steps in adjusting the subset for these extra parameters. Firstly the format in card image 002 of section 4.1 must be altered. This can be done as follows. Replace the "6X" at the end of the format with "I3,A1,I3,A1". This lengthens each data cycle by 2 bytes so that one can no longer fit 46 data cycles into a data cycle record. It is therefore necessary to change the 46 to 43.

Thus card image 002 and 003 will read:

```
4            43(2I4,I5,I4,A1,1X,I4,A1,1X,I3,A1,1X,I3,A1,I3,A1,I3,A1),     002
4            34X)                                                         003
```

The final step is to add to the plain language comments being inserted onto the GF3 data tape, a statement as to the convention used in defining the zero upcrossing wave.

The principles given for adding the above parameters to this particular subset apply equally to the addition of parameters to the other subsets. In each case, it will be necessary to alter the contents of the series header definition record and/or the data cycle definition record.

3.6 PARAMETER CODES AND USER ASSIGNMENT OF PARAMETER CODES

The information presented in this guide on parameter codes is not and cannot be up to date. The parameter coding tables for GF3 are continually growing as new codes are assigned to meet the demand for exchange of more and more parameters. The tables presented in the Annexes are intended to provide for the exchange of the parameters defined in section 3.4 and in the standard subsets included here. Users are encouraged to contact the RNODC-FORMATS on a regular basis to obtain the latest and most complete versions of the coding tables.

The absence from the code table of an entry for a particular parameter should, in no way, inhibit the user from including the parameter in a GF3 tape. The GF3 coding scheme has been designed to permit and encourage the assignment of parameter codes by the user when no standard GF3 code is available. However, when a parameter code is user assigned, the user must include details of the assignment in a plain language comments field on the GF3 tape in order that the receiving centre can know the meaning of the code.

Annex E contains extracts from Tables 7, 7a, 7b, 7c, 7d and 7f from Volume 2, "Technical Description of the GF3 Format and Code Tables". These tables relate to the parameters of interest to wave data exchange.

3.7 OVERVIEW OF GF3 DOCUMENTATION

The GF3 formatting system is described in IOC Manuals and Guides No. 17, a five volume series entitled "GF3 - A General Formatting System for Geo-Referenced Data".

Volume 1 is entitled "Introductory Guide to the GF3 Formatting System". This volume is useful as a first presentation of the formatting system and its supporting software. For the GF3 beginner, it gives an overview of the system without undue detail.

Volume 2, "Technical Description of the GF3 Format and Code Tables", is the detailed specification for GF3. It describes the types of records permitted in the system and gives a byte by byte description of the use of the fields. If one wants to take full advantage of the more sophisticated features of GF3, in particular the automatic processing features, then one must be familiar with the contents of this volume.

Volume 2 also describes the parameter coding scheme and contains the coding tables. Anyone creating or reading GF3 tapes will have to refer to the coding tables in this volume. Users are reminded that the latest version of the coding tables will reside in the RNODC-FORMATS and that those requiring the latest coding information will have to acquire it from that source.

Volume 3, "Standard Subsets of the GF3 Format", contains a description of the approved standard subsets. It will contain, for example, descriptions of all the subsets described in this guide.

Volume 4, "Users Guide to the GF3 Proc Software", describes a package of Fortran subroutines which has been developed by the Marine Information and Advisory Service in the U.K. to assist users in developing computer programs to read and create GF3 tapes. This volume provides an introduction and overview of GF3-Proc and explains what it does, how it works and how it is used.

Volume 5, "Reference Manual for the GF3 Proc Software", contains a detailed specification of each subroutine callable from the user's program and provides detailed instructions on how and when these routines may be used.

3.8 AVAILABILITY OF UTILITY SOFTWARE FOR GF3

3.8.1 GF3-Proc

GF3-Proc is a suite of some 50 user interface subroutines supported by some 200 other subroutines which are transparent to the user. These subroutines have been prepared by MIAS of the UK to provide a systematic and either automatic or manual reformatting between user formats and other than GF3 and with

GF3 itself. This allows the direct interfacing of user programmes to GF3 formatted data.

These subroutines have been designed to be as machine independent as possible. In addition versions of GF3-Proc exist for several of the more widely used computer systems. Two of the publications (Volumes 4 and 5) mentioned in the previous section describe GF3-Proc in detail.

3.8.2 GF3 Interface Programs

Users who develop useful programs and those who develop GF3 standard subsets are encouraged to deposit these programs and documentation in the RNODC-FORMATS. Information on the availability of such programs can be obtained from the RNODC-FORMATS. In addition MIAS of the UK has agreed to give technical support to the operations of the RNODC-FORMATS.

There is a variety of computer programs presently under development or planned in several National Oceanographic Data Centers. These programs or subroutines will be deposited in the RNODC-FORMATS. Examples include subroutines to load wave data into the wave data subsets and extract data from the subsets into the computer.

ANNEX A

Terms of Reference of RNODC-WAVES

TERMS OF REFERENCE OF RNODC-WAVES

1. Compile comprehensive inventories of instrumented wave data, using a standard reporting from and a world-wide community national co-ordinators for wave data.

2. Bank wave data values for remote sensed satellite altimeter wave data and produce data products at level-2 and above.

3. Assist the WDCs, Oceanography through production of a world catalogue of instrumental wave data and forward data to the WDCs where these are held.

4. Provide services to users which include advice on wave data management, on wave data products, and on specialized data products derived from remote sensed data; sales of the world wave data catalogue.

5. Prepare a report and work closely with the Technical Committee on IODE, through its Group of Experts on RNODCs and Climate Data Services highlighting new developments and ensuring the provision of expert knowledge on instrumented and remote sensed satellite wave data to the data centres, PIANC, subsidiary bodies and other international organizations.

ANNEX B

The RNODC - Waves Inventory Form

MIAS REFERENCE NO:
RECEIPT DATE:

RESPONSIBLE NATIONAL OCEANOGRAPHIC DATA CENTRE (WAVES)

Marine Information and Advisory Service of the Institute
of Oceanographic Sciences of UK in association with the
Permanent International Association of Navigation Congresses (PIANC),
and IOC Working Committee on International Oceanographic Data Exchange

INSTRUMENTAL WAVE DATA INFORMATION

for inventory purposes or to accompany submission of data

PART I : IDENTIFICATION OF DATA

1.1 Source responsible for the data and from whom the data or further information may be obtained

Name

Organization

Address

Telex No

1.2 Name and location of wave measurement site (or cruise/flight identifiers including start/end dates) *(put Lat/Long in 2.2b)*

1.3 Start and End dates of Wave Measurements (ignore temporary breakdowns)

Start d /m /y

End d /m /y

Success rate

Overall data return %

1.4 Other information which may be necessary to identify the data

PART I should always be completed and, where no data are transmitted, PART II which represents the essential minimum of additional information required for inventory purposes. When the form accompanies data, it is essential that sufficient information is provided to fully qualify the data for future users. Where convenient, entries may be replaced by references to other documents forwarded either with this form or previous forms. Metric units are preferred. If space allowed is not adequate please use additional pages.

Return this completed form to:

(1) Name
Address

or

(2) RNODC (Waves)
Marine Information and Advisory Service
Institute of Oceanographic Sciences
Wormley, Godalming, Surrey GU8 5UB, UK
Telex No. 858833 OCEANS G

Please enter your name below:

Form completed by

Name

Date

Form Aug 80

PART II : INVENTORY

2.1 Report Title (if published)

2.2 Description of Measurement Site

a) Sea Area

b) Latitude and Longitude (express as range if necessary)

c) Mean Water depth

d) Mean Tidal Range
Spring

Neap

e) Approximate maximum currents (if known)

2.3 Description of Measurements

a) Type of instrument (e.g. Waverider, resistance staff, pressure gauge, altimeter, etc.)

b) Type of instrument mounting (e.g. ship, aircraft, tripod on sea bed, midwater mooring, etc.)

c) Digital sampling frequency (if applicable)

d) Duration of individual records

e) Interval between starts of successive records

2.4 Comment on presence of offshore bars, structures or obstructions, and whether or not their presence would make the data untypical of the area

2.5 Primary reason for measurements (brief statement)

2.6 List any other observations made with the wave measurements

2.7 Data available - state form and medium in which available to other users (state NONE where none available)

a) Original Data (e.g. chart records, analogue mag. tape records, etc.)

b) Processed Data (e.g. listings of Tucker-Draper statistics, spectral estimates on mag. tape, etc.)

c) Analysis Presentations (e.g. exceedance diagrams, period histograms, etc.)

QUESTIONNAIRE FORM PARTS I AND II

PART III : DATA DOCUMENTATION
IIIA : INSTRUMENTATION

3.1 Have you previously forwarded an inventory for this set of data? YES/NO

3.2 Description of Instrument

a) Name of Instrument including Manufacturer and Model No

b) Pertinent physical characteristics (including modifications)

c) Depth of sensors below, or height above, mean water level

Height of sensors above sea floor (if more appropriate)

d) Recording Medium (e.g. strip chart, digital magnetic tape, analogue magnetic tape, etc.) (ignore if entered in 2.7a)

e) Date and Method of calibrations (please state if not calibrated) and comment on stability of calibration

f) Steps taken to control biological fouling (if applicable)

3.3 Instrument Remarks (Specify operation failures during data collection, instrumental response characteristics, e.g. bandwidth and range, chart speed or other comments helpful in data interpretation)

PART III : Continued
IIIB : DATA PROCESSING

3.4 a) Type of processing performed on data (e.g. spectral, Tucker-Draper, etc.)

b) Main start and end dates of processed data

3.5 Remarks on Data Reduction and Processing. (Include any comments pertinent to the interpretation of the data, e.g. description of methods used in deriving parameters, corrections applied to the data, filtering performed on the data, etc.)

3.6 a) Are the data checked and edited? YES/NO

b) What criteria were used for the editing and quality assessment of the data?

3.7 General Remarks (Enter any other comments useful in interpretation and use of data reported)

3.8 If transmitting data for the first time in computer compatible form please append a detailed description of its format and a detailed definition of each data field including units

QUESTIONNAIRE FORM PART III

ANNEX C

GF3 Subsets for Wave Data Exchange

Approved by the Working Committee
on IODE Group of Experts on
Format Development - October 1983

STANDARD GF3 SUBSET
FOR
WAVE HEIGHT-PERIOD DATA

1. STANDARD SUBSET

1.1 This subset is designed for time series of waveheight and wave period where these parameters are some form of statistical representation of the original wave records e.g. characteristic waveheight (4*RMS waveheight) and peak period of the wave spectrum.

1.2 The data files are configured as multi-series data files as illustrated in section 3.

1.3 Each data series contains a time series of data from a given location ordered in ascending sequence of time. Within the series each data cycle contains date, time, wave record duration, characteristic waveheight, and peak period of the spectrum, together with the associated wind speed and direction parameters as defined by the definition record given in 4.1. Each of the wave and wind parameters is followed by a quality control flag.

1.4 Each data cycle record is designed to carry up to 46 data cycles - blank characters in the format specification permit a neat 80 column layout. Note that the year of observation is defined as a header parameter and is included once only in each data cycle record. If the year changes, than the data should be continued starting with a new data cycle record.

1.5 Wind data is only entered if available in close proximity of the wave measuring site - otherwise wind speed and direction are set to their null values. The geographic co-ordinates of the wind measuring site and the circumstances of the wind measurements (particularly anemometer height) should be included in the plain language records.

1.6 Null values are not specified for the parameters YEAR, DATE and HHMM - these fields are mandatory. The user formatted area of the series header record is not used in this subset and should be left blank.

1.7 Liberal use should be made of the plain language records following the file header or series header records, as appropriate, so as to ensure that the data are adequately described and documented.

1.8 A common method for analysing wave records is by the Tucker-Draper method (see e.g. L. Draper (1966) - 'The Analysis and Presentation of Wave Data - A Plea for Uniformity', Proc. 10th Coastal Engineering Conf., Tokyo, Vol. 1, pp. 1-11). An extended version of the basic subset has been developed to cater for data analysed by this method - it can be used simply by replacing the data cycle definition record in 4.1 by that in 4.2. The format is virtually the same as that of the basic subset except that the data cycles contain five additional parameters and each data cycle record can only store up to 23 discrete data cycles.

Footnote: For a complete description of the GF3 format please refer to IOC Manuals and Guides No. 17

2. USER OPTIONS

2.1 It is recognised that there are many different methods for analysing a wave record e.g. height and period could be determined as the mean height and period of the highest one third waves (a list of such parameters and their definitions may be found in the GF-3 Code Tables Manual).

The basic subset, as defined in 4.1, assumes that wave height is expressed as characteristic wave height (i.e. 4*RMS) and that wave period is expressed as the peak period of the wave spectrum. To accommodate other types of wave height and period the user simply modifies the parameter code given in columns 3-10 of line images 008 and 010 of the data cycle definition record (i.e. VCAR7FXD and VTPK7FXD) and the respective parameter names given in columns 14-40.

For example, for a Tucker-Draper type analysis producing only significant wave height and mean zero crossing period (without the additional parameters given in the Extended Subset of 4.2) one could use the basic subset of 4.1 by simply replacing VCAR7FXD by VTDH7MBD and VTPK7FXD by VTZA7MBD and modifying the parameter name.

2.2 The example given above also illustrates the use of the method field in the parameter code (characters 6+7):-

FX - parameter derived by a Fourier analysis of a wave record obtained from an unspecified type of sensor.

MB - parameter derived by manual analysis of chart record obtained from a shipborne wave recorder.

The user can select the appropriate method code from the list given in the GF-3 Code Tables Manual. If the method codes vary within a tape or file they can be set to 'XX' i.e. unspecified, in which case the methods should be clearly identified in the plain language records.

2.3 Additional parameters may be added to the data cycles simply by adding to the end of the list of parameters in the data cycle definition record and by modifying the format specification in a similar fashion to that by which the Tucker-Draper Subset (in 4.2) was created out of the basic subset (in 4.1). Whenever possible the format specification should be designed so as to retain a neat 80 column layout in the data cycle record.

2.4 If the same data cycle definition record (including its method codes) is applicable to all data on the tape, then it need only be inserted once i.e. in the tape header file. If not, then an appropriate data cycle definition record should be inserted at the head of each data file instead of in the tape header file as shown in 3.

2.5 The grouping of data series into files is at the user's discretion, for example he may wish to store only related data in the same file or alternatively, group all his data in one single file.

3. TAPE STRUCTURE

Test File	Test Records	
	EOF	
Tape Header File	Tape Header Record Plain Language Record(s) Data Cycle Definition Record	
	EOF	
Data File 1	File Header Record Plain Language Record(s)	
	Series Header Record Plain Language Record(s) Data Cycle Records . . .	Location 1
	Series Header Record Plain Language Record(s) Data Cycle Records . . .	Location 2
	etc. . . .	| | |
	EOF	
Data File 2 . . . etc. . . .	. . . .	
	EOF	
Tape Terminator File	File Header Record (dummy entries) End of Tape Record	
	EOF	
	EOF	

4. DEFINITION RECORDS

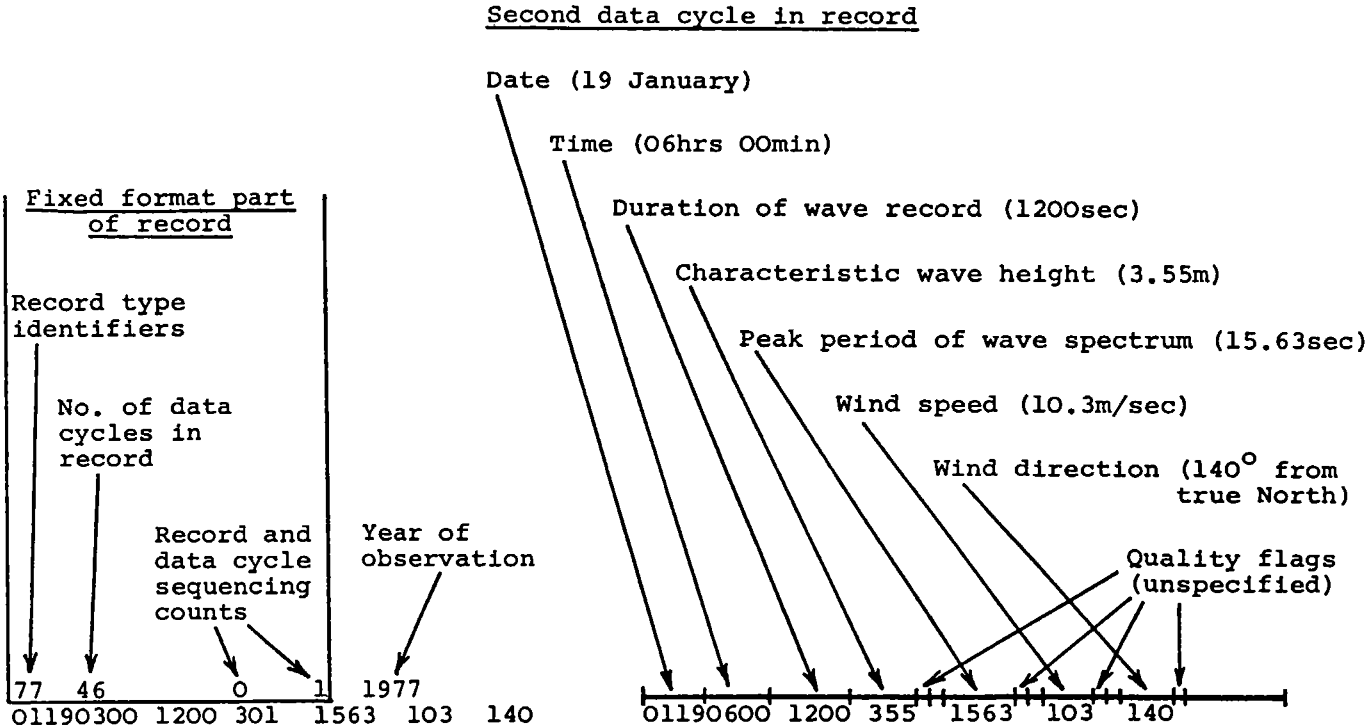
4.1 Data Cycle Definition Record

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45   1 11P        (2X,I4,54X,                                                001
4                 46(2I4,I5,I4,A1,1X,I4,A1,1X,I3,A1,1X,I3,A1,6X))            002
4                                                                            003
4 YEAR7ZSN    YEAR(START OF WAVE RECORD) I   4       1.0     0.0             004
4 DATE7ZSN    DATE(MMDD) GMT (START REC.)I   4       1.0     0.0             005
4 HHMM7ZSN    TIME(HHMM) GMT (START REC.)I   4       1.0     0.0             006
4 DRSC7PRN    DURATION OF RECORD  (SECS.)I   5 95    1.0     0.0             007
4 VCAR7FXD    CHAR.WAVE HGHT.(4*RMS) (M) I   4 94   0.01     0.0             008
4 FFFF7AAN    Q.C.FLAG FOR WAVEHEIGHT    A   1                               009
4 VTPK7FXD    WAVE SPEC. PEAK PERIOD(SEC)I   4 94   0.01     0.0             010
4 FFFF7AAN    Q.C.FLAG FOR WAVE PERIOD   A   1                               011
4 WSPD7XXA    WIND SPEED (M/SEC)         I   3 93    0.1     0.0             012
4 FFFF7AAN    Q.C.FLAG FOR WIND SPEED    A   1                               013
4 WDIR7XXA    WIND DIRECTION(DEG.TRUE N.)I   3 93    1.0     0.0             014
4 FFFF7AAN    Q.C.FLAG FOR WIND DIRECTIONA   1                               015
4                                                                            016
4                                                                            017
4                                                                            018
4                                                                            019
4                                                                            020
4                                                                            021
4                                                                            022
4                                                                            023
4                                                                            024
```

4.2 Data Cycle Definition Record (modified to cater for output from Tucker-Draper analysis)

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45   1 16P        (2X,I4,54X,                                                001
4                 23(2I4,I5,I4,A1,1X,I4,A1,1X,I3,A1,1X,I3,A1,3X,5I4,23X))    002
4                                                                            003
4 YEAR7ZSN    YEAR(START OF WAVE RECORD) I   4       1.0     0.0             004
4 DATE7ZSN    DATE(MMDD) GMT (START REC.)I   4       1.0     0.0             005
4 HHMM7ZSN    TIME(HHMM) GMT (START REC.)I   4       1.0     0.0             006
4 DRSC7PRN    DURATION OF RECORD  (SECS.)I   5 95    1.0     0.0             007
4 VTDH7MBD    TUCKER/DRAPER SIG.HGHT.(M) I   4 94   0.01     0.0             008
4 FFFF7AAN    Q.C. FLAG FOR WAVEHEIGHT   A   1                               009
4 VTZA7MBD    ZERO CROSSING PERIOD(SECS.)I   4 94   0.01     0.0             010
4 FFFF7AAN    Q.C. FLAG FOR WAVE PERIOD  A   1                               011
4 WSPD7XXA    WIND SPEED (M/SEC)         I   3 93    0.1     0.0             012
4 FFFF7AAN    Q.C. FLAG FOR WIND SPEED   A   1                               013
4 WDIR7XXA    WIND DIRECTION(DEG.TRUE N.)I   3 93    1.0     0.0             014
4 FFFF7AAN    Q.C.FLAG FOR WIND DIRECTIONA   1                               015
4 VMXL7MBD    HEIGHT OF HIGHEST CREST (M)I   4 94   0.01     0.0             016
4 VMNL7MBD    DEPTH  OF LOWEST TROUGH (M)I   4 94   0.01     0.0             017
4 VTKC7MBD    HEIGHT 2ND.HIGHEST CREST(M)I   4 94   0.01     0.0             018
4 VTKD7MBD    DEPTH  2ND.LOWEST TROUGH(M)I   4 94   0.01     0.0             019
4 VTCA7MBD    MEAN CREST PERIOD (SECS)   I   4 94   0.01     0.0             020
4                                                                            021
4                                                                            022
4                                                                            023
4                                                                            024
```

5. ANNOTATED LISTING OF SAMPLE DATA CYCLE RECORD FORMATTED ACCORDING TO THE DEFINITION GIVEN IN 4.1



```
77  46        0    1  1977
01190300 1200 301  1563  103  140       01190600 1200 355  1563  103  140
01190900 1200 357  1563  113  140       01191200 1200 373  1357   88  140
01191500 1200 381  1563   67  150       01191800 1200 393  1563   82  140
01192100 1200 361  1357   93  130       01200000 1200 317  1357  108  120
01200300 1200 336  1357  118  130       01200600 1200 314   887  118  130
01200900 1200 321  1357   93  160       01201200 1200 315  1198   98  160
01201500 1200 297  1072  108  150       01201800 1200 309  1072  113  140
01202100 1200 278  1072   72  120       01210000 1200 240   971   82  120
01210300 1200 213  1072   98  120       01210600 1200 221  1198   88  110
01210900 1200 211  1357  113   90       01211200 1200 239  1357  139  120
01211500 1200 243  1198  124  150       01211800 1200 227  1198  103  160
01212100 1200 261   704   82  160       01220000 1200 266   756  108  160
01220300 1200 258   658   98  170       01220600 1200 233   756   72  170
01220900 1200 207  1198  999  999       01221200 1200 187   756  999  999
01221500 1200 199  1072   67  180       01221800 1200 188   756  999  999
01222100 1200 215   658   67  180       01230000 1200 205   756   67  170
01230300 1200 194   816   57  170       01230600 1200 186   552   62  170
01230900 1200 181   619   52  150       01231200 1200 214  1845   72  170
01231500 1200 221  1563   62  170       01231800 1200 256  1563   62  170
01232100 1200 239  1357   57  180       01240000 1200 343  1563   52  170
01240300 1200 302  1563   46  150       01240600 1200 299  1563   62  170
01240900 1200 338  1563   82  170       01241200 1200 322  1845   93  160
01241500 1200 310  1563  108  130       01241800 1200 297  1357  124  130

         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Approved by the Working Committee
on IODE Group of Experts on
Format Development - October 1983

STANDARD GF3 SUBSET
FOR
MEASURED WAVE SPECTRA

1. STANDARD SUBSET

1.1 The subset is designed for spectra of surface wave elevation variance computed directly from instrumental measurements.

1.2 The data files are configured as multi-series data files as illustrated in section 3.

1.3 Each data series contains a time series of individual spectra from a given location; each individual spectrum being designed to map into a single data cycle record, as defined by the definition record given in section 4.

1.4 Each data cycle record contains a number of header parameters, common to the spectrum as a whole, followed by a maximum of 138 spectral estimate data cycles each containing the frequency associated with an individual spectral estimate, together with the spectral density of the estimate itself. The data cycles are ordered in ascending sequence of frequency. Blank characters in the format specification permit a neat 80 column layout.

1.5 If the individual spectrum exceeds more than 138 spectral estimates, the spectrum may be continued on the next data cycle record by use of the header parameter CCCC7AAN which is set as follows:

0 : individual spectrum completed within this data cycle record
1 : individual spectrum continues on next data cycle record

The header parameters in the second data cycle record should be identical to those in the first, except for the overflow indicator which will be set to zero unless the spectrum overflows onto yet more data cycle records. Note that the number of spectral estimate data cycles in each record is contained in characters 3 to 6 of the data cycle record. A new data cycle record is started for each individual spectrum.

1.6 The parameters wind speed, wind direction, characteristic wave height and peak period of the wave spectrum are also included with each spectrum so as to enable the recipient of the tape to select and study spectra according to wind or wave conditions. Wind data are only entered if available in close proximity of the wave measuring site - otherwise wind speed and direction are set to their null values. The geographic co-ordinates of the wind measuring site and the circumstances of the wind measurements (particularly anemometer height) should be included in the plain language records.

Footnote: For a complete description of the GF3 format please refer to IOC Manuals and Guides No. 17

1.7 Two single character quality control flag parameters (FLAG) are included for each spectrum - their usage is user defined. The user should clearly describe in the plain language records how each of these flags is used. Blank characters are entered if the flags are not used.

1.8 Null values are not specified for the parameters YEAR, DATE, HHMM and CCCC. In this subset, these fields are mandatory for each data cycle record. Similarly, the field SPCF and its preceding EEEE field are mandatory for each data cycle.

1.9 The user formatted area of the series header record is not used in this subset and should be left blank.

1.10 Liberal use should be made of the plain language records following the file header or series header records, as appropriate, so as to ensure that the data are adequately described and documented.

2. USER OPTIONS

The subset has been designed as a fixed format which the user is not encouraged to modify. However, the subset does include a number of user options.

2.1 The grouping of data series into files is at the user's discretion; for example he may wish to store only related series in the same file e.g. data series from an array of moorings during a specific cruise, from a specific fixed station or from a specific laboratory. Alternatively he may wish to group all his data in the same file.

2.2 The subset as defined in section 4 assumes that the wave data have been derived by the Fourier Analysis of recordings from an accelerometer buoy i.e. the relevant method fields have been set to 'FA' in columns 8-9 of the data cycle definition record. If other methods are in use, these entries should be modified according to the appropriate method codes given in the GF-3 Parameter Code Table. Alternatively, they may be set to 'XX' i.e. unspecified, in which case the methods should be clearly identified in the plain language records.

2.3 If the same data cycle definition record (including its method codes) is applicable to all data on the tape, then it need only be inserted once i.e. in the tape header file. If not, then an appropriate data cycle definition record should be inserted at the head of each data file following the plain language records, if any, instead of in the tape header file as shown in 3.

3. TAPE STRUCTURE

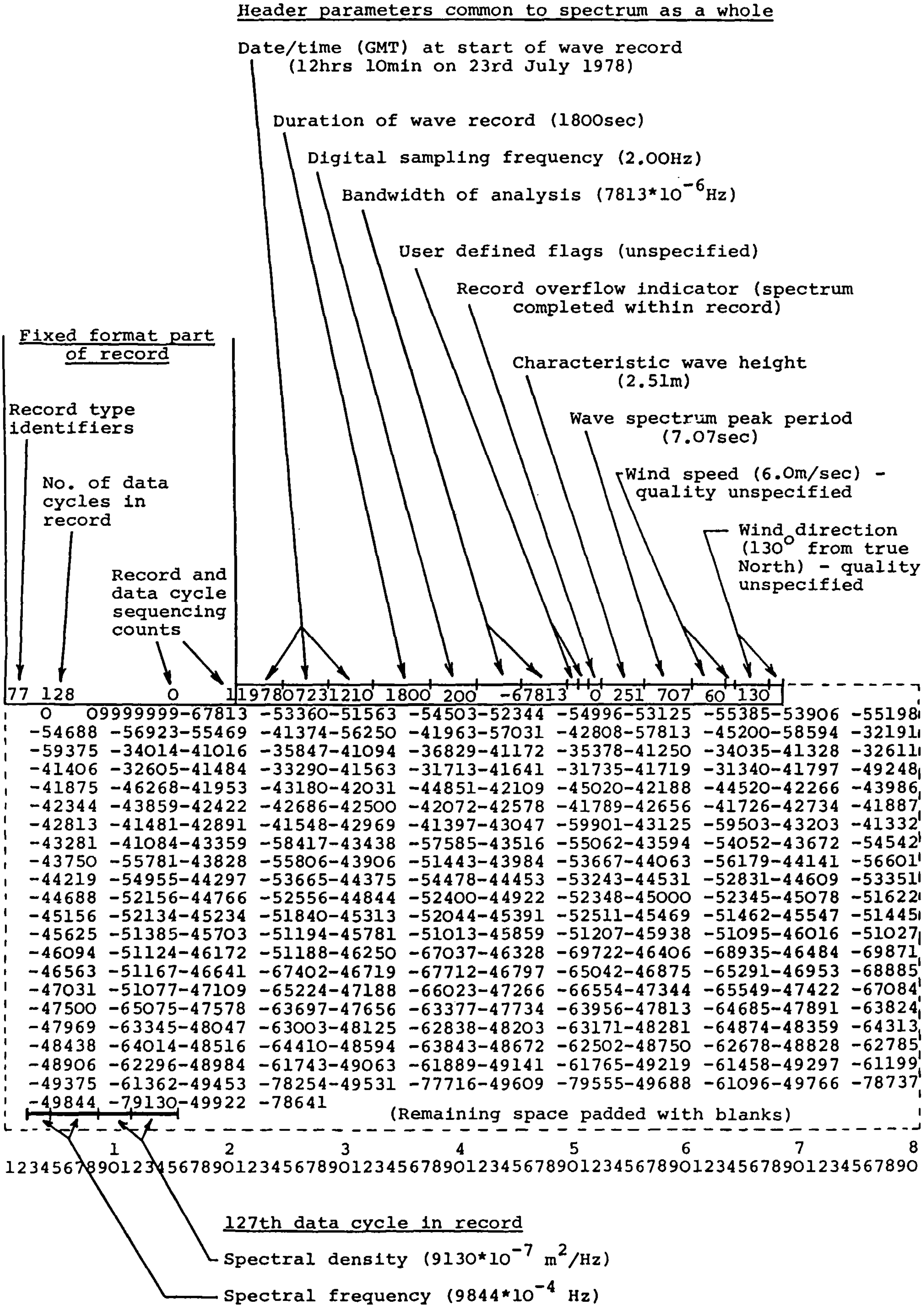
Test File	Test Records		
	EOF		
Tape Header File	Tape Header Record Plain Language Record(s) Data Cycle Definition Record		
	EOF		
Data File 1	File Header Record Plain Language Record(s) Series Header Record Plain Language Record(s)		Location 1
	Data Cycle Record . .	Spectrum 1	
	Data Cycle Record . . etc. . .	Spectrum 2 ¦	
	Series Header Records Plain Language Record(s) Data Cycle Records . . . etc. . . .		Location 2 ¦
	EOF		
Data File 2 . . . etc. . . .	. . . .		
	EOF		
Tape Terminator File	File Header Record (dummy entries) End of Tape Record		
	EOF		
	EOF		

4. DEFINITION RECORDS

4.1 Data Cycle Definition Record

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45 16  4P        (3I4,I5,3I4,2A1,I1,2I4,2(I3,A1),12X,                        001
4                23(2X,6(I2,I4,I3,I4)))                                      002
4                                                                            003
4 YEAR7ZSN   YEAR(START OF WAVE RECORD) I   4        1.0     0.0             004
4 DATE7ZSN   DATE(MMDD) GMT (START REC.)I   4        1.0     0.0             005
4 HHMM7ZSN   TIME(HHMM) GMT (START REC.)I   4        1.0     0.0             006
4 DRSC7PRN   DURATION OF RECORD    (SEC)I   5 95     1.0     0.0             007
4 FREQ7SSN   DIGITAL SAMPLING FREQ. (HZ)I   4 94    0.01     0.0             008
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   4 94     1.0     0.0             009
4 BAND7XXN   BANDWIDTH OF ANALYSIS  (HZ)I   4 94     1.0     0.0             010
4 FLAG2XXN  1USER DEFINED FLAG          A   1                                011
4 FLAG2XXN  2USER DEFINED FLAG          A   1                                012
4 CCCC7AAN   DATA CYCLE OVERFLOW INDIC. I   1        1.0     0.0             013
4 VCAR7FAD   CHARACTERISTIC WAVE HT. (M)I   4 94    0.01     0.0             014
4 VTPK7FAD   WAVE SPEC. PEAK PERIOD(SEC)I   4 94    0.01     0.0             015
4 WSPD7XXA   WIND SPEED          (M/SEC)I   3 93     0.1     0.0             016
4 FFFF7AAN   Q.C.FLAG FOR WIND SPEED    A   1                                017
4 WDIR7XXA   WIND DIRECTION(DEG.TRUE N.)I   3 93     1.0     0.0             018
4 FFFF7AAN   Q.C.FLAG FOR WIND DIRECTIONA   1                                019
4 EEEE7XXN   POWER OF TEN FOR FREQUENCY I   2        1.0     0.0             020
4 SPCF7XXN   FREQ.OF SPECTRAL EST.  (HZ)I   4        1.0     0.0             021
4 EEEE7XXN   POWER OF TEN FOR SPEC.DENS I   3 93     1.0     0.0             022
4 VSDN7FAD   SPECTRAL DENSITY  (M**2/HZ)I   4 94     1.0     0.0             023
4                                                                            024
```

5. ANNOTATED LISTING OF SAMPLE DATA CYCLE RECORD FORMATTED ACCORDING TO THE DEFINITION GIVEN IN 4.1 - A SINGLE COMPLETE SPECTRUM



```
77 128        0    1197807231210 1800 200  -67813  0 251 707  60 130
   0    09999999-67813 -53360-51563 -54503-52344 -54996-53125 -55385-53906 -55198
 -54688 -56923-55469 -41374-56250 -41963-57031 -42808-57813 -45200-58594 -32191
 -59375 -34014-41016 -35847-41094 -36829-41172 -35378-41250 -34035-41328 -32611
 -41406 -32605-41484 -33290-41563 -31713-41641 -31735-41719 -31340-41797 -49248
 -41875 -46268-41953 -43180-42031 -44851-42109 -45020-42188 -44520-42266 -43986
 -42344 -43859-42422 -42686-42500 -42072-42578 -41789-42656 -41726-42734 -41887
 -42813 -41481-42891 -41548-42969 -41397-43047 -59901-43125 -59503-43203 -41332
 -43281 -41084-43359 -58417-43438 -57585-43516 -55062-43594 -54052-43672 -54542
 -43750 -55781-43828 -55806-43906 -51443-43984 -53667-44063 -56179-44141 -56601
 -44219 -54955-44297 -53665-44375 -54478-44453 -53243-44531 -52831-44609 -53351
 -44688 -52156-44766 -52556-44844 -52400-44922 -52348-45000 -52345-45078 -51622
 -45156 -52134-45234 -51840-45313 -52044-45391 -52511-45469 -51462-45547 -51445
 -45625 -51385-45703 -51194-45781 -51013-45859 -51207-45938 -51095-46016 -51027
 -46094 -51124-46172 -51188-46250 -67037-46328 -69722-46406 -68935-46484 -69871
 -46563 -51167-46641 -67402-46719 -67712-46797 -65042-46875 -65291-46953 -68885
 -47031 -51077-47109 -65224-47188 -66023-47266 -66554-47344 -65549-47422 -67084
 -47500 -65075-47578 -63697-47656 -63377-47734 -63956-47813 -64685-47891 -63824
 -47969 -63345-48047 -63003-48125 -62838-48203 -63171-48281 -64874-48359 -64313
 -48438 -64014-48516 -64410-48594 -63843-48672 -62502-48750 -62678-48828 -62785
 -48906 -62296-48984 -61743-49063 -61889-49141 -61765-49219 -61458-49297 -61199
 -49375 -61362-49453 -78254-49531 -77716-49609 -79555-49688 -61096-49766 -78737
 -49844 -79130-49922 -78641
                                  (Remaining space padded with blanks)

         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Approved by the Working Committee
on IODE Group of Experts on
Format Development - October 1983

STANDARD GF3 SUBSET
FOR
DIGITAL WAVE RECORDS

1. STANDARD SUBSET

1.1 This subset is designed for the exchange of wave records containing digital surface elevation data at or near their original sampling frequency (~1 Hz) - an individual 'wave record' being defined as a single uninterrupted burst of such sampling.

1.2 The data files are configured as multi-series files with each series containing a time series of 'wave records' from a given location ordered in ascending sequence of time as illustrated in section 3.

1.3 Each data cycle record (as defined in 4.1) contains a number of header parameters common to the 'wave record' as a whole viz. date and time (GMT) of start of the record, duration of the record and the digital sampling frequency. These are followed by a maximum of 368 data cycles, ordered in ascending time sequence, each containing a single value of surface elevation relative to some arbitrary level which might be the mean of the 'wave record'.

1.4 It should be noted that the time of each data cycle is not stored but is derived implicitly from the position of the data cycle in the 'wave record' and the interval between successive data cycles (i.e. the inverse of the digital sampling frequency). It is essential therefore that any gaps in the 'wave record', such as might be caused by isolated spikes, should be padded with null values.

1.5 Each individual 'wave record' starts on a new data cycle record and the continuation of the 'wave record' onto succeeding data cycle records is controlled by use of the header parameter CCCC7AAN which is set as follows:-

0 : 'wave record' completed within this data cycle record
1 : 'wave record' continues on next data cycle record

The header parameters in the second and succeeding data cycle records of the 'wave record' should be identical to those in the first, except for the overflow indicator which will be set to zero unless the 'wave record' overflows onto yet more data cycle records. Note that the number of surface elevation values in each data cycle record is contained in characters 3 to 6 of the data cycle record.

1.6 The format specification for the data cycle records has been chosen to permit a neat 80 column layout. Note that null values are not specified for the parameters YEAR, DATE, HHMM, FREQ and CCCC. These fields are mandatory for each data cycle record. In this subset the user formatted area of the series header records has not been used and should be left blank.

Footnote: For a complete description of the GF3 format please refer to IOC Manuals and Guides No. 17

1.7 Liberal use should be made of the plain language records following the file header or series header records, as appropriate, so as to ensure that the data are adequately described and documented.

2. USER OPTIONS

2.1 The grouping of data series into files is at the user's discretion; for example, he may wish to store only related data in the same file or alternatively group all his data in one single file.

2.2 Additional parameters may be appended to the data cycles simply by adding to the end of the list of parameters in the data cycle definition record and by modifying the Fortran format specification. Wherever possible the format specification should be chosen so as to retain a neat 80 column layout in the data cycle record with an integral number of data cycles per line image.

For example, with a pitch/roll buoy the user may wish to include surface slope values with the surface elevation data e.g. N-S and E-W tilt angles. Assuming these are each expressed as I4 fields, the modification can be achieved by adding North-South Tilt and East-West Tilt parameters to the list of parameters and by replacing 368(I5) in the format specification by 23(6(I5,I4,I4),2X)) i.e. allowing 138 discrete data cycles per data cycle record. See section 4.2.

Alternatively, the user may wish to store, for example, heave acceleration instead of surface elevation. To do this he should replace the entry defining the surface elevation parameter in the data cycle definition record by an appropriate specification for heave acceleration(parameter code VWSA 7 XX D) - care should be taken to modify the Fortran format specification in bytes 98-157 if the field length is also to be changed.

2.3 If the user has modified the format as outlined in 2.2 and if this results in different formats applying to each data file, then the appropriate data cycle definition record should be inserted at the head of each data file following the plain language records, if any, and not in the tape header file as shown in 3.

3. TAPE STRUCTURE

Test File
Test Records

EOF

Tape Header File
Tape Header Record
Plain Language Record(s)
Data Cycle Definition Record

EOF

Data File 1
File Header Record
Plain Language Record(s)
Series Header Record
Plain Language Record(s)
Data Cycle Record 'Wave Record' 1 Location 1
.
.
Data Cycle Records 'Wave Record' 2
.
.
etc.
.
.
Series Header Records
Plain Language Record(s)
Data Cycle Records Location 2
.
.
.
etc.
.
.
.
EOF
.
.
.

Data File 2
.
.
.
etc.
.
.
.
EOF

Tape Terminator File
File Header Record (dummy entries)
End of Tape Record

EOF

EOF

4. DEFINITION RECORDS

4.1 Data Cycle Definition Record

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45  6  1I         (2X,I4,1X,I4,1X,I4,1X,I5,I4,1X,I1,32X,                    001
4                 368(I5))                                                   002
4                                                                            003
4 YEAR7ZSN   YEAR(START OF WAVE RECORD) I   4        1.0     0.0             004
4 DATE7ZSN   DATE(MMDD) GMT (START REC.)I   4        1.0     0.0             005
4 HHMM7ZSN   TIME(HHMM) GMT (START REC.)I   4        1.0     0.0             006
4 DRSC7PRN   DURATION OF RECORD  (SECS.)I   5 95     1.0     0.0             007
4 FREQ7SSN   DIGITAL SAMPLING FREQ. (HZ)I   4       0.01     0.0             008
4 CCCC7AAN   DATA CYCLE OVERFLOW INDIC. I   1        1.0     0.0             009
4 VWSE7XXD   WATER SURFACE ELEVATION (M)I   5 95    0.01     0.0             010
4                                                                            011
4                                                                            012
4                                                                            013
4                                                                            014
4                                                                            015
4                                                                            016
4                                                                            017
4                                                                            018
4                                                                            019
4                                                                            020
4                                                                            021
4                                                                            022
4                                                                            023
4                                                                            024
```

4.2 Extension of subset to include surface slope measurements

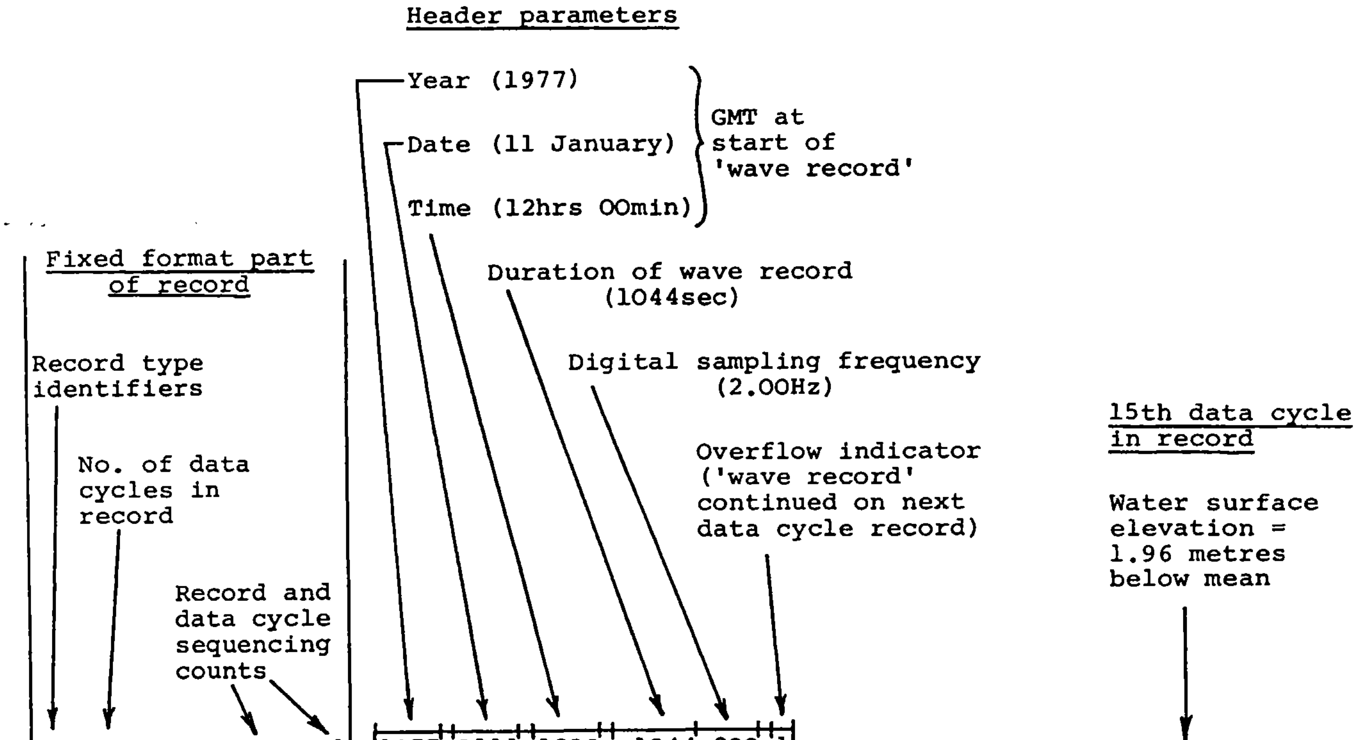
The subset may be extended to accommodate N-S and E-W surface tilt measurements by modifying line images 001 and 002 of the data cycle definition record as follows:

```
45  6  3I         (2X,I4,1X,I4,1X,I4,1X,I5,I4,1X,I1,32X,                    001
4                 23(6(I5,I4,I4),2X))                                        002
```

and by inserting specifications for the N-S tilt and E-W tilt parameters in line images 011 and 012 as follows:

```
4 VWTN7XXD   NORTH-SOUTH TILT(DEG)NUP+VEI   4 94     0.1     0.0             011
4 VWTE7XXD   EAST-WEST TILT(DEG) E UP+VEI   4 94     0.1     0.0             012
```

5. ANNOTATED LISTING OF SAMPLE DATA CYCLE RECORD FORMATTED ACCORDING TO THE DEFINITION GIVEN IN 4.1



```
77 368        0    1 1977 0111  1200  1044 200 1
 -198 -168  -52   66  100   56   40   66  120  152   34  -38  -86 -194 -196 -148
  -60  -94  -54   -8  -66  -58  -94 -168 -110  -12   94  158   34 -162 -216 -254
 -196  -88   96  206  194  116  118   48  -16  -40  -98 -152 -216 -300 -326 -240
 -236 -174  -44   60  120  136   86   40   16    0   68   86   38  -98 -178 -150
  -48   16    8 -158 -168 -168  -92   38   56   16    4  -20  -60  -14   28   54
   72   -8  -92 -184 -304 -400 -322  -88   34   78  118  146  108   80   46   22
   78   90   40  -44 -144 -210 -212 -210 -166 -144  -98 -120  -66   56  132  148
   94  -34 -128 -132 -148  -80  -24  -12  -62 -166 -136  -52   36  112  112   48
    4  -74 -114  -68   48   46   -8 -102 -178 -156 -194 -130  -88  -22    0 -102
 -162 -104  -38   22   98   20  -58   44   98   90  116   94  100   60  -68 -190
 -310 -304 -272 -204 -176 -162 -118  -62   -4   30   98  176  222  184   88   76
   92  -34 -166 -252 -318 -212 -182 -208 -140  -48   68  118   76   56    8 -100
 -144 -176 -146  -40  -28   56   34 -108 -108 -100  -40   30    4  -40   16   72
   48   -8  -48  -48  -36  -60 -136 -176 -216 -194 -132 -102   48   -8   76  148
  104  -20  -52  -48  -23   16  -16  -66 -136 -198 -226 -150  -68   48   68   68
   56   22  104   66  -68 -168 -162 -130  -54  -86  -72   -4  -40  -66 -116 -118
  -84  -66  -12   44   20   22   92   98   20   72   88  -48 -110 -180 -252 -268
 -262 -180  -76  110  214   80  -66 -118 -108 -112  -40   46   36  -52  -42  -40
  -24   12  -38  -84 -112 -200 -136  -40   86  136   94  120   54  -62 -152 -244
 -294 -318 -268 -156  -98  -20   16   20   62   30   98  126  142  174  144   74
    4  -46   -2  -12 -130 -232 -272 -362 -446 -388 -272 -184 -104   34  180  200
  240  254  148  134  180  162   66    2  -36  -84 -232 -380 -460 -372 -332 -248
 -106  -40   24   40  118  176  120  110  150  166  118   66   -8 -136 -274 -204

         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Approved by the Working Committee
on IODE Group of Experts on
Format Development - January 1987

STANDARD GF3 SUBSET
FOR
DIRECTIONAL WAVE SPECTRAL DATA

1. STANDARD SUBSET

1.1 This subset is intended for the exchange of directional wave spectral information originating from instruments measuring wave direction or from numerical wave models that calculate wave spectra from input wind fields in either a hindcast or forecast mode.

1.2 The data files are configured as multi-series files with each series containing the directional wave data for a given location. Within each series, the data are ordered in ascending time sequence. The structure of the tape and of the tape files is illustrated in section 3.

1.3 There are three possible structures for the data cycle records in this subset. The first structure is for data for which the directional characteristics of the wave field are reported at each frequency as co-spectra and quadrature spectra between the heave and tilt signals. The second structure is for data for which the directional characteristics are reported as spectral densities as a function of frequency and direction band. If directional spectra have been computed from the co and quadrature spectra the data can be reported in the second structure.

1.4 The third structure is for reporting directional wave parameters calculated from co- and quadrature spectra in terms of variance spectral densities, mean directions of propagation, and directional spreads as a function of frequency. Some additional parameters have been provided which are useful in evaluating the performance of the buoy and some other characteristics of the wave field. These parameters would generally be of most use to researchers studying wave processes. Included, for example, are the zero expectation cross spectra.

1.5 The data cycle records for each of the three structures contain a number of header parameters common to the 'wave record' as a whole. Examples of these parameters are date and time (GMT) of start of the record, duration of the record, the digital sampling frequency, the calculated significant wave height, etc. These parameters are followed by a number of data cycles containing frequency or frequency and direction dependant variables that describe the directional properties of the wave field.

Footnote: For a complete description of the GF3 format please refer to IOC Manuals and Guides No. 17

1.6 For the second structure where the directional data are reported as spectral densities in frequency and direction bands it is assumed that there are discreet direction bands of equal size. This is the case for example when a wave model is used that reports directional density for say 15 frequencies and 16 directions.

1.7 If there are co and quadrature estimates at more than 22 frequencies in structure 1 or spectral estimates at more than 44 frequency-direction combinations in structure 2 or 22 combinations in structure 3 then the information is continued on the next data cycle record by use of the header parameter CCCC7AAN which is set as follows:

0 : data from a single wave record completed within this data cycle record

1 : data continues on next data cycle record

1.8 The header parameters in the second and subsequent data cycle records within a given wave record should be identical to those in the first, except for the overflow indicator which will be set according to whether the data overflows onto yet more data cycle records. Note that the number of data cycles of information in each record is contained in characters 3 to 6 of the data cycle record. A new data cycle record is started for each individual wave record.

1.9 The parameters wind speed, wind direction, characteristic wave height and peak period of the wave spectrum are also included with each spectrum so as to enable the recipient of the tape to select and study spectra according to wind or wave conditions. Wind data should only be included if they are from a nearby location that can be considered as representative of the wind conditions at the wave measuring site or over the wave generation area. The geographic co-ordinates of the wind measuring site and the circumstances of the wind measurements (particularly anemometer height) should be included in the plain language records.

1.10 Two single character quality control flag parameters (FLAG) are included for each wave record - their usage is user defined. The user should clearly describe in the plain language records how each of these flags is used. Blank characters are entered if the flags are not used.

1.11 Null values are not specified for the parameters YEAR, DATE, HHMM, and CCCC. In this subset, these fields are mandatory for each data cycle record. Similarly, the field SPCF and its preceding EEEE field are mandatory for each data cycle.

1.12 The user formatted area of the series header record is not used in this subset and should be left blank.

1.13 Liberal use should be made of the plain language records following the file header or series header records, as appropriate, so as to ensure that the data are adequately described and documented.

2. USER OPTIONS

The subset has been designed as a fixed format which the user is not encouraged to modify unless he wishes to exchange parameters or information not provided for in the data definition records. However, the subset does include a number of user options.

2.1 The grouping of data series into files is at the user's discretion: for example he may wish to store only related series in the same file e.g. data series from an array of wave buoys, from a specific fixed station or from a specific wave hindcast. Alternatively he may wish to group all his data in the same file.

2.2 If the same data cycle definition record (including its method codes) is applicable to all data on the tape, then it need only be inserted once i.e. in the tape header file. If not, then an appropriate data cycle definition record should be inserted at the head of each data file instead of in the tape header file as shown in 3.

3. TAPE STRUCTURE

```
Test File            | Test Records
                     |
                       EOF
                     |
Tape Header File     | Tape Header Record
                     | Plain Language Record(s)
                     | Data Cycle Definition Record
                       EOF
                     | File Header Record
                     | Plain Language Record(s)
                     | Series Header Record
                     | Plain Language Record(s)
                     | Data Cycle Record          | Wave Record 1  |Location 1
                     |     .                      |      .         |     .
                     |     .                             .         |     .
                     | Data Cycle Record          | Wave Record 2  |    etc.
                     |     .                      |      .         |     .
                     |     .                             .         |     .
Data File 1          |    etc.                          etc.       |     .
                     |     .                             .         |     .
                     |     .                             .         |     .
                     | Series Header Record
                     | Plain Language Record(s)
                     | Data Cycle Record          | Wave Record 1  | Location 2
                     |     .                      |      .         |     .
                     |     .                             .         |     .
                     | Data Cycle Record          | Wave Record 2  |    etc.
                     |     .                      |      .         |     .
                     |     .                             .         |     .
Data File 1          |    etc.                          etc.       |     .
                     |     .                             .         |     .
                     |     .                             .         |     .
                       EOF
                     |  .
                     |  .
Data File 2          |  .
     .               |  .
     .               |  .
     .               |  .
   etc.              |  .
     .               |  .
     .               |  .
     .               |  .
     .               |  .
                       EOF

Tape Terminator File | File Header Record (dummy entries)
                     | End of Tape Record

                       EOF
                       EOF
```

4. DEFINITION RECORDS

4.1 Data Cycle Definition Record for Directional Wave Data in the form of Co and Quad Spectra

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

44 19 22P        (3(1X,I4),45X,1X,I5,1X,I4,1X,I3,1X,I4,1X,2A1,I1,2(1X,I4),   001
4                2(1X,I3,A1),1X,I4,2(1X,I3),23X,20(2(1X,I3,I4),9(I3,I5)))    002
4                                                                            003
4 YEAR7ZSN   YEAR(START OF WAVE RECORD) I   4        1.0     0.0             004
4 DATE7ZSN   DATE(MMDD) GMT (START REC.)I   4        1.0     0.0             005
4 HHMM7ZSN   TIME(HHMM) GMT (START REC.)I   4        1.0     0.0             006
4 DRSC7PRN   DURATION OF RECORD    (SEC)I   5 95     1.0     0.0             007
4 FREQ7SSN   DIGITAL SAMPLING FREQ. (HZ)I   4 94    0.01     0.0             008
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   3 93     1.0     0.0             009
4 BAND7XXN   BANDWIDTH OF ANALYSIS  (HZ)I   4 94     1.0     0.0             010
4 FLAG2XXN  1USER DEFINED FLAG          A   1                                011
4 FLAG2XXN  2USER DEFINED FLAG          A   1                                012
4 CCCC7AAN   DATA CYCLE OVERFLOW INDIC. I   1        1.0     0.0             013
4 VCAR7FAD   CHARACTERISTIC WAVE HT  (M)I   4 94    0.01     0.0             014
4 VTPK7FAD   WAVE SPEC. PEAK PERIOD(SEC)I   4 94    0.01     0.0             015
4 WSPD7XXA   WIND SPEED          (M/SEC)I   3 93     0.1     0.0             016
4 FFFF7AAN   Q.C. FLAG FOR WIND SPEED   A   1                                017
4 WDIR7XXA   WIND DIRECTION(DEG.TRUE N.)I   3 93     1.0     0.0             018
4 FFFF7AAN   Q.C.FLAG FOR WIND DIRECTIONA   1                                019
4 VSMC7XXD   AVERAGE APPARENT PER. (SEC)I   4 94    0.01     0.0             020
4 VMED7XXD   MEAN ENERGY DIRECTION (DEG)I   3 93     1.0     0.0             021
4 VPED7XXD   PEAK ENERGY DIRECTION (DEG)I   3 93     1.0     0.0             022
4 EEEE7XXN   POWER OF TEN FOR FREQUENCY I   3        1.0     0.0             023
4 SPCF7XXN   FREQ. OF SPECTRAL EST. (HZ)I   4        1.0     0.0             024
```

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45                                                                           025
4                                                                            026
4                                                                            027
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   3 93     1.0     0.0             028
4 BEST7XXN   BANDWIDTH OF SPEC EST  (HZ)I   4 94     1.0     0.0             029
4 EEEE7XXN   POWER OF TEN FOR POWER SPECI   3 93     1.0     0.0             030
4 VSDN7XXD   POWER SPEC.    (HEAVE)     I   5 95     1.0     0.0             031
4 EEEE7XXN   POWER OF TEN FOR VCXX, C22 I   3 93     1.0     0.0             032
4 VCXX7XXD   AUTO SPEC(NS TILT UP TO N) I   5 95     1.0     0.0             033
4 EEEE7XXN   POWER OF TEN FOR VCYY, C33 I   3 93     1.0     0.0             034
4 VCYY7XXD   AUTO SPEC(EW TILT UP TO E) I   5 95     1.0     0.0             035
4 EEEE7XXN   POWER OF TEN FOR VQZX, Q12 I   3 93     1.0     0.0             036
4 VQZX7XXD   QUAD SPEC (HEAVE, N-S TILT)I   5 95     1.0     0.0             037
4 EEEE7XXN   POWER OF TEN FOR VQZY, Q13 I   3 93     1.0     0.0             038
4 VQZY7XXD   QUAD SPEC (HEAVE, E-W TILT)I   5 95     1.0     0.0             039
4 EEEE7XXN   POWER OF TEN FOR VQXY, Q23 I   3 93     1.0     0.0             040
4 VQXY7XXD   QUAD SPEC (NS TILT,EW TILT)I   5 95     1.0     0.0             041
4 EEEE7XXN   POWER OF TEN FOR VCZX, C12 I   3 93     1.0     0.0             042
4 VCZX7XXD   CO SPEC (HEAVE, N-S TILT)  I   5 95     1.0     0.0             043
4 EEEE7XXN   POWER OF TEN FOR VCZY, C13 I   3 93     1.0     0.0             044
4 VCZY7XXD   CO SPEC (HEAVE, E-W TILT)  I   5 95     1.0     0.0             045
4 EEEE7XXN   POWER OF TEN FOR VCXY, C23 I   3 93     1.0     0.0             046
4 VCXY7XXD   CO SPEC (NS TILT, EW TILT) I   5 95     1.0     0.0             047
4                                                                            048
```

4.2 Data Cycle Definition Record for Directional Wave Data in the form of Energy Density by Frequency and Direction

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

44 20   7P       (3(1X,I4),45X,1X,I5,1X,I4,1X,I3,2(1X,I4),1X,2A1,I1,2(1X,I4),001
4                2(1X,I3,A1),1X,I4,2(1X,I3),18X,44(3X,I3,2X,I4,2X,I3,        002
4                2(2X,I4),2X,I3,2X,I4))                                      003
4 YEAR7ZSN   YEAR(START OF WAVE RECORD) I   4        1.0     0.0             004
4 DATE7ZSN   DATE(MMDD) GMT (START REC.)I   4        1.0     0.0             005
4 HHMM7ZSN   TIME(HHMM) GMT (START REC.)I   4        1.0     0.0             006
4 DRSC7PRN   DURATION OF RECORD    (SEC)I   5 95     1.0     0.0             007
4 FREQ7SSN   DIGITAL SAMPLING FREQ. (HZ)I   4 94    0.01     0.0             008
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   3 93     1.0     0.0             009
4 BAND7XXN   BANDWIDTH OF ANALYSIS  (HZ)I   4 94     1.0     0.0             010
4 BDIR7XXN   BANDW.DIREC.ANALYSIS  (DEG)I   4 94     0.1     0.0             011
4 FLAG2XXN  1USER DEFINED FLAG          A   1                                012
4 FLAG2XXN  2USER DEFINED FLAG          A   1                                013
4 CCCC7AAN   DATA CYCLE OVERFLOW INDIC. I   1        1.0     0.0             014
4 VCAR7FAD   CHARACTERISTIC WAVE HT  (M)I   4 94    0.01     0.0             015
4 VTPK7FAD   WAVE SPEC. PEAK PERIOD(SEC)I   4 94    0.01     0.0             016
4 WSPD7XXA   WIND SPEED          (M/SEC)I   3 93     0.1     0.0             017
4 FFFF7AAN   Q.C. FLAG FOR WIND SPEED   A   1                                018
4 WDIR7XXA   WIND DIRECTION(DEG.TRUE N.)I   3 93     1.0     0.0             019
4 FFFF7AAN   Q.C.FLAG FOR WIND DIRECTIONA   1                                020
4 VSMC7XXD   AVERAGE APPARENT PER. (SEC)I   4 94    0.01     0.0             021
4 VMED7XXD   MEAN ENERGY DIRECTION (DEG)I   3 93     1.0     0.0             022
4 VPED7XXD   PEAK ENERGY DIRECTION (DEG)I   3 93     1.0     0.0             023
4 EEEE7XXN   POWER OF TEN FOR FREQUENCY I   3        1.0     0.0             024
```

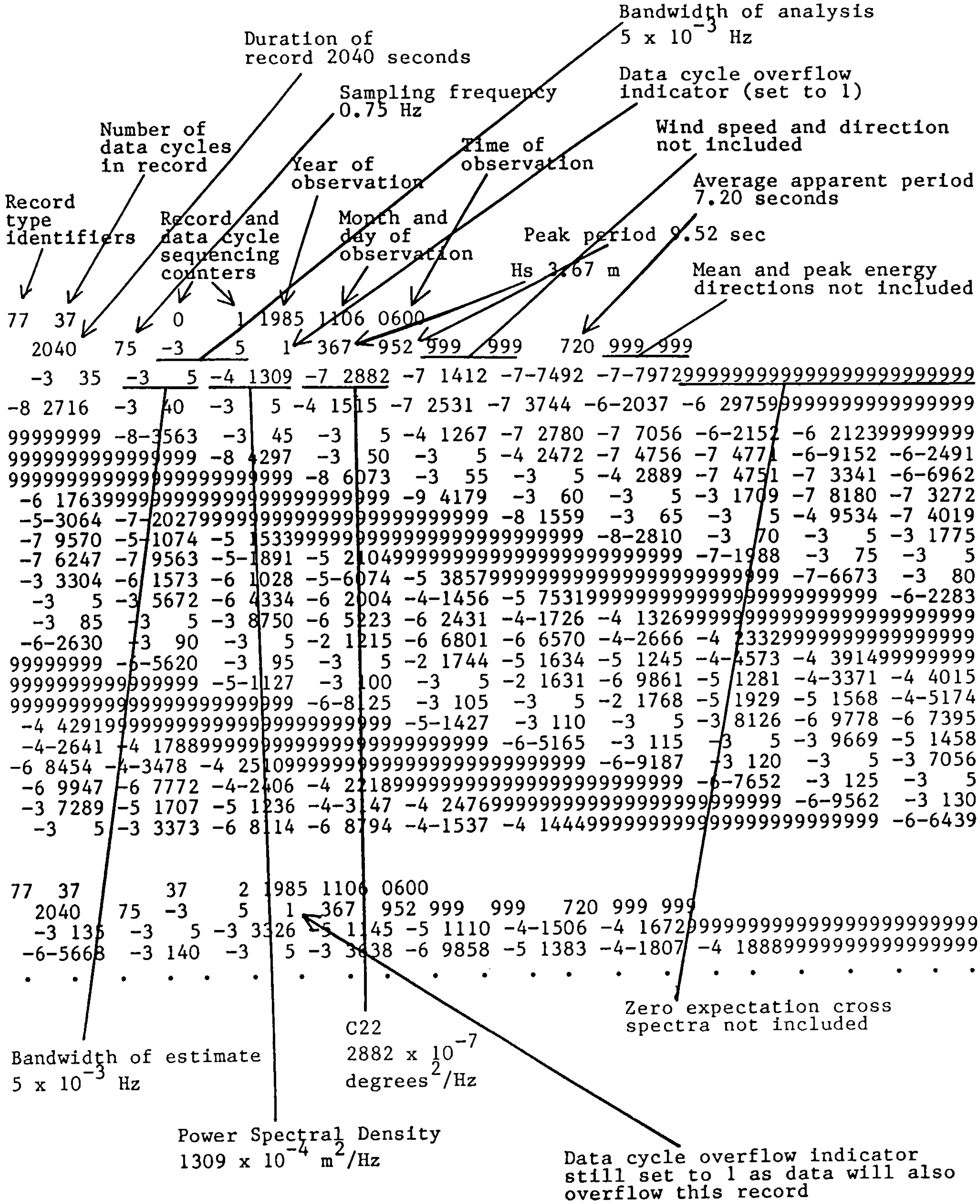
```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45                                                                           025
4                                                                            026
4                                                                            027
4 SPCF7XXN   FREQ. OF SPECTRAL EST. (HZ)I   4        1.0     0.0             028
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   3 93     1.0     0.0             029
4 BEST7XXN   BANDWIDTH OF SPEC EST  (HZ)I   4 94     1.0     0.0             030
4 VDEP7XXD   DIREC OF ENERGY PROP. (DEG)I   4 94     0.1     0.0             031
4 EEEE7XXN   POWER OF TEN FOR SPEC.DENS I   3 93     1.0     0.0             032
4 VDSD7XXD   DIRECTIONAL SPEC. DENS.    I   4 94     1.0     0.0             033
4                                                                            034
4                                                                            035
4                                                                            036
4                                                                            037
4                                                                            038
4                                                                            039
4                                                                            040
4                                                                            041
4                                                                            042
4                                                                            043
4                                                                            044
4                                                                            045
4                                                                            046
4                                                                            047
4                                                                            048
```

4.3 Data Cycle Definition Record for Directional Wave Data in the Form of Energy Density, Direction, and Other Parameters Derived from the Co- and Quadrature Spectra, all as a Function of Frequency.

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

44 19 16P        (3(1X,I4),45X,1X,I5,1X,I4,1X,I3,1X,I4,1X,2A1,I1,2(1X,I4),   001
4                2(1X,I3,A1),1X,I4,2(1X,I3),23X,22(3(2X,I3,1X,I4),1X,I4,1X,  002
4                I3,2(1X,I3),3(2X,I3,1X,I5)))                                003
4 YEAR7ZSN   YEAR(START OF WAVE RECORD) I   4          1.0     0.0             004
4 DATE7ZSN   DATE(MMDD) GMT (START REC.)I   4          1.0     0.0             005
4 HHMM7ZSN   TIME(HHMM) GMT (START REC.)I   4          1.0     0.0             006
4 DRSC7PRN   DURATION OF RECORD    (SEC)I   5 95       1.0     0.0             007
4 FREQ7SSN   DIGITAL SAMPLING FREQ. (HZ)I   4 94      0.01     0.0             008
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   3 93       1.0     0.0             009
4 BAND7XXN   BANDWIDTH OF ANALYSIS  (HZ)I   4 94       1.0     0.0             010
4 FLAG2XXN  1USER DEFINED FLAG          A   1                                  011
4 FLAG2XXN  2USER DEFINED FLAG          A   1                                  012
4 CCCC7AAN   DATA CYCLE OVERFLOW INDIC. I   1          1.0     0.0             013
4 VCAR7FAD   CHARACTERISTIC WAVE HT  (M)I   4 94      0.01     0.0             014
4 VTPK7FAD   WAVE SPEC. PEAK PERIOD(SEC)I   4 94      0.01     0.0             015
4 WSPD7XXA   WIND SPEED          (M/SEC)I   3 93       0.1     0.0             016
4 FFFF7AAN   Q.C. FLAG FOR WIND SPEED   A   1                                  017
4 WDIR7XXA   WIND DIRECTION(DEG.TRUE N.)I   3 93       1.0     0.0             018
4 FFFF7AAN   Q.C.FLAG FOR WIND DIRECTIONA   1                                  019
4 VSMC7XXD   AVERAGE APPARENT PER. (SEC)I   4 94      0.01     0.0             020
4 VMED7XXD   MEAN ENERGY DIRECTION (DEG)I   3 93       1.0     0.0             021
4 VPED7XXD   PEAK ENERGY DIRECTION (DEG)I   3 93       1.0     0.0             022
4 EEEE7XXN   POWER OF TEN FOR FREQUENCY I   3          1.0     0.0             023
4 SPCF7XXN   FREQ. OF SPECTRAL EST. (HZ)I   4          1.0     0.0             024

         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

45                                                                           025
4                                                                            026
4                                                                            027
4 EEEE7XXN   POWER OF TEN FOR BANDWIDTH I   3 93       1.0     0.0             028
4 BEST7XXN   BANDWIDTH OF SPEC EST  (HZ)I   4 94       1.0     0.0             029
4 EEEE7XXN   POWER OF TEN FOR SPEC.DENS I   3 93       1.0     0.0             030
4 VSDN7XXD   POWER SPECTRAL DEN M**2/HZ I   4 94       1.0     0.0             031
4 VMWD7XXD   DIR PROP FOR FREQ BAND(DEG)I   4 94       0.1     0.0             032
4 VSPR7XXD   DIRECTIONAL SPREAD    (DEG)I   3 93       1.0     0.0             033
4 EEEE7XXN   POWER OF TEN FOR WAVENUMBERI   3 93       1.0     0.0             034
4 VNUM7XXD   WAVENUMBER FROM CO AND QUADI   3 93       1.0     0.0             035
4 EEEE7XXN   POWER OF TEN FOR VQXY, Q23 I   3 93       1.0     0.0             036
4 VQXY7XXD   QUAD SPEC (NS TILT,EW TILT)I   5 95       1.0     0.0             037
4 EEEE7XXN   POWER OF TEN FOR VCZX, C12 I   3 93       1.0     0.0             038
4 VCZX7XXD   CO SPEC (HEAVE, N-S TILT)  I   5 95       1.0     0.0             039
4 EEEE7XXN   POWER OF TEN FOR VCZY, C13 I   3 93       1.0     0.0             040
4 VCZY7XXD   CO SPEC (HEAVE, E-W TILT)  I   5 95       1.0     0.0             041
4                                                                            042
4                                                                            043
4                                                                            044
4                                                                            045
4                                                                            046
4                                                                            047
4                                                                            048
```

5. ANNOTATED LISTING OF SAMPLE DATA CYCLE RECORD FOR DIRECTIONAL WAVE DATA

5.1 In the form of Co and Quad Spectra



```
77  37          0          1 1985 1106 0600
 2040    75   -3     5     1   367   952 999   999    720 999 999
  -3  35  -3    5 -4 1309 -7 2882 -7 1412 -7-7492 -7-797299999999999999999999999
-8 2716  -3  40  -3    5 -4 1515 -7 2531 -7 3744 -6-2037 -6 29759999999999999999
99999999 -8-3563  -3  45  -3    5 -4 1267 -7 2780 -7 7056 -6-2152 -6 212399999999
9999999999999999 -8 4297  -3  50  -3    5 -4 2472 -7 4756 -7 4771 -6-9152 -6-2491
999999999999999999999999 -8 6073  -3  55  -3    5 -4 2889 -7 4751 -7 3341 -6-6962
 -6 176399999999999999999999999999 -9 4179  -3  60  -3    5 -3 1709 -7 8180 -7 3272
 -5-3064 -7-2027999999999999999999999999 -8 1559  -3  65  -3    5 -4 9534 -7 4019
 -7 9570 -5-1074 -5 1533999999999999999999999999 -8-2810  -3  70  -3    5 -3 1775
 -7 6247 -7 9563 -5-1891 -5 2104999999999999999999999999 -7-1988  -3  75  -3    5
 -3 3304 -6 1573 -6 1028 -5-6074 -5 3857999999999999999999999999 -7-6673  -3  80
  -3    5 -3 5672 -6 4334 -6 2004 -4-1456 -5 7531999999999999999999999999 -6-2283
  -3  85  -3    5 -3 8750 -6 5223 -6 2431 -4-1726 -4 1326999999999999999999999999
 -6-2630  -3  90  -3    5 -2 1215 -6 6801 -6 6570 -4-2666 -4 2332999999999999999999
99999999 -6-5620  -3  95  -3    5 -2 1744 -5 1634 -5 1245 -4-4573 -4 391499999999
9999999999999999 -5-1127  -3 100  -3    5 -2 1631 -6 9861 -5 1281 -4-3371 -4 4015
999999999999999999999999 -6-8125  -3 105  -3    5 -2 1768 -5 1929 -5 1568 -4-5174
 -4 429199999999999999999999999999 -5-1427  -3 110  -3    5 -3 8126 -6 9778 -6 7395
 -4-2641 -4 1788999999999999999999999999 -6-5165  -3 115  -3    5 -3 9669 -5 1458
 -6 8454 -4-3478 -4 2510999999999999999999999999 -6-9187  -3 120  -3    5 -3 7056
 -6 9947 -6 7772 -4-2406 -4 2218999999999999999999999999 -6-7652  -3 125  -3    5
 -3 7289 -5 1707 -5 1236 -4-3147 -4 2476999999999999999999999999 -6-9562  -3 130
  -3    5 -3 3373 -6 8114 -6 8794 -4-1537 -4 1444999999999999999999999999 -6-6439


77  37         37          2 1985 1106 0600
 2040    75   -3     5     1   367   952 999   999    720 999 999
  -3 135  -3    5 -3 3326 -5 1145 -5 1110 -4-1506 -4 16729999999999999999999999999
 -6-5668  -3 140  -3    5 -3 3638 -6 9858 -5 1383 -4-1807 -4 1888999999999999999999
  .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
```

5.2 · In the form of energy density by frequence and direction

These variables have the same definitions as the example in section 5.1

Directional bandwidth of directional spectral analysis is 22.5 degrees

Frequency of spectral estimate is 35 x 10^{-3} Hz

Direction of energy propagation is 22.5 degrees

Bandwidth of spectral estimate is 5 x 10^{-3} Hz

Directional spectral density is 4 x 10^{-1} m^2/Hz.degree

```
77  61          0    1 1983 0906 1201
  2040   75  -3     5  225    1  540 1250  999   999   829  999  240
   -3   35   -3     5  225   0     0    -3    35   -3     5   450    0     0
   -3   35   -3     5  675   0     0    -3    35   -3     5   900    0     0
   -3   35   -3     5 1125   0     0    -3    35   -3     5  1350    0     0
   -3   35   -3     5 1575   0     0    -3    35   -3     5  1800   -1     1
   -3   35   -3     5 2025  -1     3    -3    35   -3     5  2250   -1     4
   -3   35   -3     5 2475  -1     4    -3    35   -3     5  2700   -1     5
   -3   35   -3     5 2925  -1     4    -3    35   -3     5  3150   -1     3
   -3   35   -3     5 3375  -1     2    -3    35   -3     5     0   -1     1
   -3   40   -3     5  225   0     0    -3    40   -3     5   450    0     0
   -3   40   -3     5  675   0     0    -3    40   -3     5   900    0     0
   -3   40   -3     5 1125   0     0    -3    40   -3     5  1350    0     0
   -3   40   -3     5 1575  -1     2    -3    40   -3     5  1800   -1     3
   -3   40   -3     5 2025  -1     4    -3    40   -3     5  2250   -1     5
   -3   40   -3     5 2475  -1     4    -3    40   -3     5  2700   -1     4
   -3   40   -3     5 2925  -1     3    -3    40   -3     5  3150   -1     2
   -3   40   -3     5 3375  -1     1    -3    40   -3     5     0    0     0
   -3   45   -3     5  225   0     0    -3    45   -3     5   450    0     0
   -3   45   -3     5  675   0     0    -3    45   -3     5   900    0     0
   -3   45   -3     5 1125   0     0    -3    45   -3     5  1350    0     0
   -3   45   -3     5 1575  -1     1    -3    45   -3     5  1800   -1     2
   -3   45   -3     5 2025  -1     3    -3    45   -3     5  2250   -1     3
   -3   45   -3     5 2475  -1     3    -3    45   -3     5  2700   -1     3

77  61         61    2 1983 0906 1201
  2040   75             225    1  540 1250  999   999   829  999  240
   -3   45   -3     5 2925  -1     3    -3    45   -3     5  3150   -1     2
   -3   45   -3     5 3375  -1     1    -3    45   -3     5     0    0     0
   -3   50   -3     5  225   0     0    -3    50   -3     5   450    0     0
   -3   50   -3     5  675   0     0    -3    50   -3     5   900    0     0
   -3   50   -3     5 1125   0     0    -3    50   -3     5  1350   -1     1
   -3   50   -3     5 1575  -1     2    -3    50   -3     5  1800   -1     3
   -3   50   -3     5 2025  -1     4    -3    50   -3     5  2250   -1     5
   -3   50   -3     5 2475  -1     5    -3    50   -3     5  2700   -1     5
   -3   50   -3     5 2925  -1     4    -3    50   -3     5  3150   -1     3
   -3   50   -3     5 3375  -1     1    -3    50   -3     5     0    0     0
    .    .    .     .    .   .     .     .     .    .     .     .    .     .
    .    .    .     .    .   .     .     .     .    .     .     .    .     .
```

5.3 In the form of energy density by frequency and direction with additional parameters derived from the Co - and Quadrature Spectra

These variables have the same definitions as the example in section 5.1

Frequency of spectral estimate is 35 x 10^{-3} Hz

Bandwidth of spectral estimate is 5 x 10^{-3} Hz

Power spectral density is 5 x 10^{-1} m^2/Hz

Average direction of propagation for frequency band is 270.0 degrees

Directional spread is 39 degrees

```
77  39          0    1 1985 1106 0600
 2040   75  -3    5    1  367  952 999  999     720 999 999
  -3   35   -3    5   -1    5 2700  39 999 999   999 99999   999 99999   999 99999
  -3   40   -3    5   -1    5 2475  46 999 999   999 99999   999 99999   999 99999
  -3   45   -3    5   -1    3 2475  36 999 999   999 99999   999 99999   999 99999
  -3   50   -3    5   -1    5 2250  50 999 999   999 99999   999 99999   999 99999
  -3   55   -3    5   -1    9 2475  48 999 999   999 99999   999 99999   999 99999
  -3   60   -3    5   -1   18 2475  36 999 999   999 99999   999 99999   999 99999
  -3   65   -3    5   -1   59 2475  37 999 999   999 99999   999 99999   999 99999
  -3   70   -3    5   -1   79 2475  41 999 999   999 99999   999 99999   999 99999
  -3   75   -3    5   -1   85 2475  31 999 999   999 99999   999 99999   999 99999
  -3   80   -3    5   -1  124 2475  19 999 999   999 99999   999 99999   999 99999
  -3   85   -3    5   -1  123 2475  20 999 999   999 99999   999 99999   999 99999
  -3   90   -3    5   -1   55 2475  25 999 999   999 99999   999 99999   999 99999
  -3   95   -3    5   -1   53 2250  27 999 999   999 99999   999 99999   999 99999
  -3  100   -3    5   -1   82 2475  21 999 999   999 99999   999 99999   999 99999
  -3  105   -3    5   -1   94 2475  19 999 999   999 99999   999 99999   999 99999
  -3  110   -3    5   -1   58 2475  24 999 999   999 99999   999 99999   999 99999
  -3  115   -3    5   -1   49 2475  27 999 999   999 99999   999 99999   999 99999
  -3  120   -3    5   -1   33 2475  32 999 999   999 99999   999 99999   999 99999
  -3  125   -3    5   -1   29 2250  30 999 999   999 99999   999 99999   999 99999
  -3  130   -3    5   -1   29 2475  31 999 999   999 99999   999 99999   999 99999
  -3  135   -3    5   -1   36 2250  30 999 999   999 99999   999 99999   999 99999
  -3  140   -3    5   -1   21 2475  33 999 999   999 99999   999 99999   999 99999

77  39         39    2 1985 1106 0600
 2040   75  -3    5    0  367  952 999  999     720 999 999
  -3  145   -3    5   -1   26 2475  34 999 999   999 99999   999 99999   999 99999
  -3  150   -3    5   -1   11 2475  42 999 999   999 99999   999 99999   999 99999
   .    .    .    .    .    .    .    .   .   .     .    .       .    .       .    .
```

The wavenumber and zero expectation cross spectra have not been calculated for this data set

The data cycle overflow indicator is set to 0 as the data for the wave record will complete within this data cycle record

ANNEX D

Terms of Reference of RNODC - Formats

TERMS OF REFERENCE OF RNODC - FORMATS

1. Act as an archive centre for international marine environmental data formats, maintaining a full set of documentation on all such formats.

2. Act as an archive centre for code tables for GF3 and code tables for all other international archival formats, and for external code tables (e.g., taxonomic codes, chemical substances codes, etc.). The RNODC would maintain references to all such code tables.

3. Manage the expansion of the existing GF3 parameter code table as necessary under the guidance of the Working Committee on IODE (through its Group of Experts on Format Development or its successor) and to provide a focal point to which user requirements for new parameter codes may be directed.

4. Maintain user aids for GF3, including a programme library for processing of GF3, guidance notes and user guides, documentation of standard and experimental sub-sets of GF3, and sample data tapes of GF3 subsets.

5. Function as a centre for services to other centres in IOC and ICES Member States in such GF3 matters as responses to requests for information about, or copies of, items mentioned above.

6. Prepare a report to the Working Committee, through its Group of Experts on RNODCs, together with an annual newsletter for distribution to National Co-ordinators for IODE, National Oceanographic Data Centres, and other interested parties, such as WMO, ECOR, and SCOR, highlighting new developments in GF3 and including an updated inventory of the documents, programmes, tapes, formats and code tables available.

7. Work closely with the Group of Experts on Format Development to ensure the provision of expert knowledge on formats to other centres, including WDCs-A and -B (all disciplines) and subsidiary bodies of WMO, IOC and other international organizations and in the promotion of GF3 as an exchange format. The provision of expert knowledge will be assured in fields covering

   (a) guidance in the uses of GF3,

   (b) assistance to developing countries with the development of national formats compatible with GF3, and

   (c) assistance to developing data centres and countries, in collaboration with other RNODCs, in converting data into GF3.

ANNEX E

Minimum Necessary Documentation to Accompany Instrumental Data Exchange

MINIMUM NECESSARY DOCUMENTATION TO ACCOMPANY INSTRUMENTAL DATA EXCHANGE

The presence of an asterisk (*) beside an entry below indicates that the information has been identified as essential for the purpose of the wave data inventory maintained by the RNODC-WAVES.

(a) Location and Physical Data Concerning the Measurement Site

* (1) Latitude and longitude (for each record, if necessary, as in the case of a moving vessel, satellite or drifting buoy);

* (2) period of time covered by the measurements;

(3) mean water depth at the location of the measurement;

(4) depth of the sensor (if subsurface) below the mean water level or above the surface, if appropriate;

(5) height of the instrument above the sea bed (if subsurface pressure device);

(6) mean spring and neap tidal ranges;

(7) physical characteristics of instrument platform (e.g. ship, aircraft, rigid mounting, floating mounting, etc.);

(8) proximity of obstructions which might modify results;

(9) approximate maximum currents (if known and if the results could be modified by these currents) and a comment on the cause (e.g. tidal, wind driven, river outflow, etc.);

(10) a comment on the presence of offshore bars and whether their presence would yield the data not typical of the area;

(11) steps taken to control biological fouling (if applicable); and

(12) a list of any other physical parameters which were observed at the time the wave measurements were made.

(b) Wave Sensing Instrument

(1) Measurement principle (e.g. accelerometer, resistance staff gauge, pressure device, differential pressure device, etc.) (for little used types, a description of the operating principle and basic technical characteristics is desirable);

* (2) manufacturer and model number (if instrument is a commercially available one);

(3) pertinent physical data concerning the instrument (e.g. length (wave staff), beam angle (inverted echo sounder));

(4) deviations from ideal response of the instrument to the water surface elevation (if known);

(5) date and results of the most recent calibration of the instrument (if available) and a comment on the stability of the instrument calibration should also be included; and

(6) platform speed and course (for airborne or shipborne wave measurements).

(c) Purpose of Measurements

(1) Brief statement on the purpose for which the wave data were collected.

(d) Data Sampling and Recording Techniques

(1) Type of recording (e.g. strip chart, analog or FM analog magnetic tape, digital, etc.);

(2) chart speed (if applicable);

(3) chart width (if applicable);

(4) chart sensitivity (displacement in cm/meter of wave height) (if applicable);

(5) characteristics of any response correction or filtering applied to the wave sensor signal before recording;

* (6) duration of individual records (e.g. 20 minutes, etc.);

* (7) number of records per day (for wave climatological type of study); and

(8) time at which each wave record was taken.

(e) Analysis Procedures

(1) Type of analysis (e.g. spectrum analysis, wave-bywave analysis, Tucker analysis, analog computer analysis, etc.);

(2) details on any filtering used in the analysis phase (such as electronic filters, digital filtering, restricting the range of the integration under the spectrum, spectral smoothing techniques, etc.);

(3) digital sampling frequency (if analyzed in digital form);

(4) a statement of details on any response corrections applied to spectral estimates; and

(5) formulae used in computing derived parameters such as significant wave height, spectral width, etc. (if standard definitions in the

PIANC glossary or any subsequent similar IOC glossary are not adhered to).

(f) Other Forms in Which Results are Available

* (1) Statistical presentations such as exceedence diagrams, peak period histograms, etc.;

* (2) spectrum information in digital form (specify format and availability);

* (3) reports; and

(4) analog chart records, analog magnetic tape, etc.

(g) Sources of Further Information Concerning the Measured Wave Data

* (1) Names and addresses of the person or persons holding the wave data and most concerned with the making of the measurements and the analysis of the data.

(h) Wind Data

(1) If wind data is available for exchange with the measured wave data, the source, location, and characteristics of the wind data should be briefly described and, if possible, a reference should be given as to where further detailed information can be obtained concerning the wind measurements.

ANNEX F

List of Wave Parameters for Exchange User GF3 for Which Standard GF3 Parameter Codes Are Available, and Their Definitions

LIST OF WAVE PARAMETERS FOR EXCHANGE USER GF3 FOR WHICH STANDARD GF3 PARAMETER CODES ARE AVAILABLE, AND THEIR DEFINITIONS

Z_1	The "mean water depth" is the vertical distance between the mean water level and the bottom. Z_1 is always a positive quantity.
Z_2	The "still water depth" is the vertical distance between the still water level and the bottom. Z_2 is always a positive quantity.
Z_3	The "mean record water depth" is the vertical distance between the mean record level and the bottom. Z_3 is always a positive quantity.
Y_1	The maximum wave level is the maximum zero-crossing crest amplitude observed in a record. Note that Y_1 is always positive and is equal to $a_{z,c,max}$.
Y_2	The minimum wave level is the maximum zero-crossing trough amplitude observed in a record. Note that Y_2 is always positive and is equal to $a_{z,t,max}$.
H_{max}	The maximum wave height is the maximum H as observed in a specified period of time, which should always be stated.
$H_{c,max}$	The maximum crest-to-trough wave height is the maximum H_c as observed in a specified period of time, which should always be stated. H_c is the vertical distance between a crest and the immediately following trough. Hz,max the period of the maximum zero-crossing wave height is the interval between the two zero-crossings defining the wave. The convention used for defining Hz should be clearly stated in accompanying documentation.
$T_{z,max}$	The period of the maximum zero-crossing wave height is the interval between the two zero-crossings defining the wave. The convention used for defining T_z should be clearly stated in accompanying documentation.
$\overline{T}_z$	The zero-crossing wave period is the average of zero-crossing intervals as obtained by dividing the record duration by the number of times the water elevation crosses the mean record level in one direction.

$\overline{T}_c$	The average crest period is the time obtained by dividing the record duration by the total number of crests in this record.
ε_T	The spectral width parameter (Broadness factor) defined by $\varepsilon_T^2 = 1 - (\overline{T}_c/\overline{T}_z)^2$.
T_p	The peak period equals $1/f_p$.
S(f)	The variance spectral density function of a wave record is the density distribution of the variance as a function of positive frequency.
m_n	The nth moment of the variance spectral density function: $m_n = \int_a^b f^n S(f)df$. Typically a = 0, b = ∞. Included would be m_0, m_1, m_2 and m_4.
σ	The root mean square value is the square root of the variance or the average square displacement of the water surface from the mean record level $\sigma^2 = \overline{\eta}^2 = m_0$.
$T_{ma,b}$	The length of time defined by two spectral moments m_a and m_b. In particular, one may use the "average period" defined as m_0/m_1 or m_{-1}/m_0.
ε_s	The spectral width parameter defined by $\varepsilon_2^2 = \frac{m_0 \cdot m_4 - m_2^2}{m_0 \cdot m_4}$
Hm_0	The characteristic wave height = 4*σ for a stated period of time.
$H_{z,1/3}$	(or H_s) The average of the highest one third of the zero-crossing wave heights for a stated period of time. The convention used for defining H_z should be clearly stated in accompanying documentation. The significant wave height as estimated by other means. The method used should be clearly described in accompanying documentation.
H_s	The significant wave height as estimated by other means. The method used should be clearly described in accompanying documentation.
ϕ	The wind direction (if available).
w	The wind speed (if available).

$S(f,\theta)$	Spectral density of the variance of the water surface elevation at a specified frequency, f, due to waves coming from a specified direction, θ, within a directional band of width $\Delta\theta$
θ	Specified direction of wave energy propagation. This parameter is used for identifying a specific directional component of a directional wave spectrum, expressed relative to true North in the direction from which the waves are coming
$\Delta\theta$	Directional bandwidth of directional spectrum analysis
θm	Direction of wave propagation at the frequency of the maximum variance density, measured relative to true North in the direction from which waves are coming
θa	Mean direction of energy propagation. Within each frequency band a vector is defined having the magnitude of the wave energy within the band and the direction of the peak energy of the waves in the band. The mean energy direction is the direction of the resultant of the sum of these vectors.

The following eight parameters represent the spectral components estimated at a specified frequency, f, from the cross spectral analysis of instantaneous measurements of heave, east-west tilt and north-south tilt. The following conventions are adopted:

heave - water surface elevation in metres relative to an arbitrary mean, positive upwards

east-west tilt - water surface tilt in degrees in the east-west (true) vertical plane; measured relative to the horizontal, east upwards positive

north-south tilt - water surface tilt in degrees in the north-south (true) vertical plane; measured relative to the horizontal, north upwards positive

C22(f)	Auto-spectrum of north-south tilt
C33(f)	Auto-spectrum of east-west tilt
Q12(f)	Quadrature spectrum of heave and north-south tilt
Q13(f)	Quadrature spectrum of heave and east-west tilt
Q23(f)	Quadrature spectrum of north-south and east-west tilts
C12(f)	Co-spectrum of heave and north-south tilt
C13(f)	Co-spectrum of heave and east-west tilt
C23(f)	Co-spectrum of north-south and east-west tilts

The following parameters may be derived from the above cross spectral components (see Longuet-Higgins et al (1963), 'Observations of the Directional Spectrum of Sea Waves using the Motions of a Floating Buoy' in Ocean Wave Spectra, pp 111-132, Prentice-Hall, Englewood Cliffs):

k(f)	the wave number calculated from cross spectra which is given by $((C22(f)+C33(f))/C11(f))^{1/2}$
$\theta_1(f)$	$\theta_1(f)$ = arc tan (Q13/Q12) and gives the mean direction, relative to true North, from which the waves are coming (on the assumption that the directional distribution is unimodal) and is based on the first angular harmonics of the directional spectrum at the specified frequency
$\theta_2(f)$	$\theta_2(f) = (2-2C)^{1/2}$ where $C = ((Q12(f)^2+Q13(f)^2)/(C11(f)(C22(f)+C33(f))))^{1/2}$ For a narrow directional distribution, $\theta_2(f)$ gives the rms spread about the mean wave direction and is based on the first order angular harmonics of the directional spectrum

ANNEX G

GF3 PARAMETER CODES

Tables 7, 7A, 7B, 7C, 7D, 7F and 7G
from
Annex VII of IOC Manuals and Guides No. 17, Volume 2.
(Technical Description of the GF3 Format and Code Tables)

GF3 CODE TABLE 7 : PARAMETER CODE

(Definition Record - line image bytes 3-10 and 67-74)

STANDARD CODES

The parameter code tables for GF3 are continually growing and new standard codes are assigned to meet the demand for the exchange and archival of more and more parameters. The code tables presented in this Annex are not, and cannot be, up to date. Users are encouraged to contact RNODC (Formats) on a regular basis to obtain the latest and most complete versions of the code tables. So as to maintain compatibility with data already stored in GF3, the updating of the code tables will not involve the deletion or alteration of existing entries. Embedded within the structure of the parameter code (see overleaf) is a flag to indicate whether the code has been accepted by RNODC (Formats) as a standard code.

USER-DEFINED CODES

The absence from the code table of an entry for a particular parameter should, in no way, inhibit the user from storing that parameter in GF3. The structure of the parameter code has been designed to permit and encourage the assignment of parameter codes by the user when no standard GF3 code is available. However, when a parameter code is user assigned, the user must include a clear definition of the parameter, its code and units in a GF3 plain language comments area. Users are encouraged to use the standard codes whenever possible and, before assigning a user code, to check whether an appropriate code already exists in the standard tables.

PARAMETER CODE TABLE

The standard GF3 parameter codes are presented as ten separate tables:

Table 7A:	General purpose
Table 7B:	Date and time within day
Table 7C:	Time and frequency
Table 7D:	Position and navigation
Table 7E:	Physical oceanography
Table 7F:	Waves
Table 7G:	Meteorology
Table 7H:	Geophysics
Table 7I:	Chemistry
Table 7J:	Special purpose

STRUCTURE OF THE GF3 PARAMETER CODE

The GF3 parameter code is structured as an eight character field in the form PPPPKMMS

where PPPP = PARAMETER IDENTIFIER
K = KEY FOR USER DEFINED OPTIONS
MM = METHOD/PARAMETER QUALIFIER
S = SPHERE IDENTIFIER

PPPP (PARAMETER IDENTIFIER) is a four character upper case alphabetic (A-Z) code which identifies the parameter. The assignment of the code implies a clear definition of the parameter and the units in which it is stored. In the standard code table the units are selected to conform with SI (Systeme Internationale).

K (KEY FOR USER DEFINED OPTIONS) is a one digit key to identify those elements of the parameter code that are part of the standard code table and those that are user-defined:

K	
7	P,M,U all standard
6	P,M standard, U non standard
5	P,U standard, M non standard
4	P standard, M,U non standard
2	P,M,U all non standard

where P = parameter identifier
M = method/parameter qualifier
U = parameter units

K=7 if the parameter identifier (and hence the definition of the parameter), method/parameter qualifier and units all conform precisely with entries in the standard code table.

K=6 or 4, non standard units U implies units differing from those specified for the parameter in the standard code table.

K=5 or 4, non standard M implies the use of a user-defined method/parameter qualifier in conjunction with a standard parameter identifier.

K=2 implies that the parameter identifier (and definition of the parameter), method/parameter qualifier and units are all defined by the user.

It is essential that all of the user-defined elements are clearly described in plain language records accompanying the data, preferably at tape or file level. For K=2, this description should include a clear definition of the parameter. Whenever possible, user supplied units should conform with the SI system - if necessary the scaling factors (in the definition record) may be used to convert from non standard units. (See section 5.2.4).

MM (METHOD/PARAMETER QUALIFIER) is a two character upper case alphabetic (A-Z) code identifying the method used to measure the parameter. Alternatively, it may be used as a qualifier of the parameter itself. It is coded with respect to the parameter identifier PPPP except when it is unspecified when it is always set to 'XX'.

S (SPHERE IDENTIFIER) is a one character alphabetic code to identify the sphere in which the parameter is measured:

S		S	
A	atmosphere	G	lithosphere
B	atmosphere/hydrosphere interface	H	interstitial
C	atmosphere/lithosphere interface	J	biosphere (internal to organisms)
D	hydrosphere	N	not applicable (e.g. coordinates)
E	hydrosphere/lithosphere interface	X	unspecified

The interface spheres are used only where the parameter refers to something being transported through the interface, or where reference is made to measurements on both sides of the interface (e.g. air-sea temperature difference).

TABLE 7A

GENERAL PURPOSE PARAMETERS

Parameters in this table are organised under the headings:

- i) QUALITY CONTROL FLAGS
- ii) SPECIAL FUNCTIONS
- iii) DATA STRUCTURE EXTENSIONS
- iv) OTHER PARAMETERS

i) PPPP K MM S QUALITY CONTROL FLAGS

FFFF 7 -- N QUALITY CONTROL FLAG

This indicates a quality control flag applicable to the value of the immediately preceding parameter in the 'user-defined area'. The method code MM indicates the flag code table in use:-

7 AA Flag coded as in GF3 Code Table 6 as follows:-

blank	Unspecified or quality control check has not been made
A	Acceptable: data found acceptable during quality control checks
S	Suspect Value: data considered suspect (but not replaced) by the data originator on the basis of either quality control checks or recorder/instrument/platform performance
Q	Questionable Value: data considered suspect (but not replaced) during quality control checks by persons other than those responsible for its original collection e.g. a data centre
R	Replaced Value: erroneous or missing data has been replaced by estimated or interpolated value - method by which replacement values have been derived should be described in plain language records
M	Missing Value: original data erroneous or missing

7 GG Flag coded according to the IGOSS system as follows:-

0	No quality control (QC) has been performed on the value
1	QC performed: value appears correct
2	QC performed: value appears inconsistent with other values
3	QC performed: value appears doubtful
4	QC performed: value appears erroneous
5	Value has been changed as a result of QC
6-8	Reserved for future use
9	Value of the parameter is missing

6 XX User defined flag code in use - consult plain language records for details

QPOS 7 -- N QUALITY CONTROL FLAG FOR GEOGRAPHIC POSITION

One character quality control flag applicable to the latitude and longitude recorded for a given geographic location. For series at a fixed position it refers to the coordinates given in characters 270-284 of the series header record - otherwise it relates to individual locations recorded in a 'user-defined area'. The method code MM indicates the flag code table in use:

AA Flag coded as for parameter FFFF7AAN above
GG Flag coded as for parameter FFFF7GGN above

QTIM 7 -- N QUALITY CONTROL FLAG FOR SERIES DATE/TIME

One character quality control flag applicable to start/end date/time entries given in bytes 242 to 269 of the series header record. The method code MM indicates the flag code table in use:

AA Flag coded as for parameter FFFF7AAN above
GG Flag coded as for parameter FFFF7GGN above

GGQF 7 -- N QUALITY CONTROL FLAGS FOR DATE, TIME, POSITION AND SEA FLOOR DEPTH

GG Contains a sequence of six single character quality control flags associated respectively with the values of: day (c8-9), month (c6-7), time (c10-13), latitude (c30-36), longitude (c37-44) and sea floor depth (c48-53) in that order, as recorded in line image 4 of the series header record. The method code MM indicates the flag code table in use:

AA Flag coded as for parameter FFFF7AAN above
GG Flag coded as for parameter FFFF7GGN above

ii) PPPP K MM S SPECIAL FUNCTIONS

EEEE 7 XX N DECIMAL EXPONENT

This power of ten is to be attached to the value of the immediately succeeding parameter in the 'user-defined area' after application of scale factors associated with that parameter (as in line bytes 49-64 of the Definition Record).
For example, if two successive parameters EEEE and ABCD contain values (after application of scale factors) of '2' and '123' respectively, the result should be interpreted as a value of 123 x 10^2 for the parameter ABCD.

SDEV 7 XX N STANDARD DEVIATION OF PRECEDING PARAMETER (units as for preceding parameter)

The standard deviation of the preceding parameter in the 'user-defined area' - not necessarily the immediately preceding parameter, e.g. in cases where the preceding parameter is followed by a quality control flag. To avoid ambiguity it is recommended that, in the definition line image defining SDEV, the secondary parameter code should reference the parameter to which the standard deviation applies.

PVAR 7 XX N VARIANCE OF PRECEDING PARAMETER (squared units of preceding parameter)

The variance of the preceding parameter in the 'user-defined area' - not necessarily the immediately preceding parameter, e.g. in cases where the preceding parameter is followed by a quality control flag. To avoid ambiguity it is recommended that, in the definition line image defining PVAR, the secondary parameter code should reference the parameter to which the variance applies.

iii) PPPP K MM S DATA STRUCTURE EXTENSIONS

The GF3 system involves a data hierarchy of four levels i.e. data cycle level, series level, file level, and tape (or dataset) level. In fact, two additional levels of hierarchy exist around the data cycle level viz:

1) Through the use of header parameters in the data cycle records it is possible to build up discrete sets of data cycles within a data series.
2) Individual data cycles can themselves be designed to contain repeating groups of parameters.

The following four parameters, CCCC, CFLG, PAIR and CHAN may be used to support these additional structures:

PPPP K MM S

CCCC 7 -- N DATA CYCLE OVERFLOW INDICATOR

This flag is used as a 'header parameter' for indicating whether or not data cycles overflow a 'user-defined area'

AA One character flag coded as follows:-

0 : data cycles completed within this record
1 : data cycles continued on the next record

Note on usage: This parameter was originally created so as to enable data cycles to overflow the 'user-defined area' of a series header record - this function is now supported by the series header continuation flag introduced into byte 397 of the series header record during the updating of GF3 to version GF3.2. The parameter is now used primarily with data cycle records to enable series to be built up as sets of data cycles, with each new set of data cycles starting with a new data cycle record. 'Header parameters' are used for information common to each individual set of data cycles, and the parameter CCCC indicates whether the set of data cycles overflows the data cycle record. When the overflow condition occurs, the 'header parameters' are repeated on the following data cycle record before continuing the data cycles.

Example of usage: A time series of wave spectra with each spectrum made up as a frequency series of spectral density(s). Each spectrum would start with a new data cycle record with 'header parameters' common to the spectrum as a whole e.g. date and time, digital sampling frequency, bandwidth and duration of sampling, while the data cycles would include parameters such as frequency and spectral density(s).

CFLG 7 -- N DATA CONTINUATION FLAG

Flag to indicate whether a data cycle represents the start of a new data sequence or the continuation of the sequence from the previous data cycle.

AA One character flag coded as follows:

0 : data cycle represents the start of a new data sequence
1 : data cycle represents the continuation of a data sequence

Note on usage: The usage of this parameter is best illustrated by an example. Consider the case of a digitized bathymetric contour chart with individual contours stored as a labelled stream of paired geographic latitude and longitude values. Each data sequence (i.e. contour) will consist of a depth value followed by a sequence of paired latitude and longitude values. However, the number of paired values is highly variable - varying from a minimum of 3 for small enclosed contours to a potentially very large number for long contour streams. A practical solution to this problem is to break the contour into segments and to map these segments into data cycles containing the parameters: contour depth, CFLG, PAIR and a fixed number (say 5) of paired latitude and longitude values. Individual contours would then consist of one or more data cycles, the parameter CFLG would maintain the link between the data cycles (i.e. the continuity of the contour) while the parameter PAIR would cover for short data cycles at the end of each sequence. The next contour stream in the series would then start in the next data cycle (irrespective of data cycle record boundaries) with CFLG reset to 0.

PAIR 7 XX N COUNT OF PARAMETER PAIRS IN DATA CYCLE

This parameter may be used in cases where the data cycles contain a variable number of repeated pairs of parameters and explicit control is required in the processing of these data. In such cases the data cycle will be defined to contain a fixed (i.e. maximum) number, n, of parameter pairs with each parameter occurrence (i.e. 2n in total) defined as a 'data cycle parameter'. The parameter PAIR may then be used to indicate how many parameter pairs in the data cycle contain actual data - the remaining parameter pairs being filled with the appropriate null values. Note that the use of this parameter implies a certain amount of redundancy as one can always deduce the number of parameter pairs in each data cycle by determining the number of pairs containing valid data as opposed to null values. Its use is therefore optional.

CHAN 7 XX N NUMBER OF SENSOR CHANNELS

This parameter is used primarily in standard GF3 subsets designed to accommodate data from a variable number of sensor channels - the subset itself being standardised to a predefined maximum number of channels. The parameter CHAN refers to the actual number of channels containing valid data in a given data series - the remaining channels being filled with appropriate null values. Its use is optional and similar to that of parameter PAIR.

MMMM 7 -- N METHOD CODE IN USER DEFINED AREA

This indicates that the method code MM appropriate to a specific stored parameter instead of being entered in bytes 8-9 of the Definition Record line image defining that stored parameter, is entered in a 'user-defined area' i.e. it is itself a header or data cycle parameter.

The Definition Record line image defining this method code parameter has bytes 3-10 set to MMMM7--N (-- being entered as below) and bytes 67-74 (secondary parameter code) set to the code of the parameter to which the method code parameter is to apply.

The code table in use is defined as follows:-

7 AA	Standard two character method code appropriate to the secondary parameter
7 FF	First character only of the standard two character method code appropriate to the specified secondary parameter (at present restricted to use with parameters TEMP, PSAL, SSAL, PRES, DEPH)
6 XX	User defined method code in use - consult plain language records for details

iv) **PPPP K MM S** OTHER PARAMETERS

TEXT 7 XX N PLAIN LANGUAGE TEXT

Used for creating plain language area in the 'user-defined area' of a series header record

IDEN 7 XX N DATA IDENTIFIER

Used in cases where an identifier is required to label data within a data series with, for example, a measurement, cast, sample, station, leg or scan number - need not be confined to numeric identifiers.

PPPP K MM S

PLAT 7 -- N PLATFORM IDENTIFIER

Used only if platform identification is required within a 'user-defined area' rather than in lines 002/003 of the series header record e.g. when data from different platforms are merged in the same series and there is a need to retain the platform identifier. The platform identifier is expressed according to the system identified in MM:-

CS	ITU call sign
BY	WMO buoy identifier $A_1b_wn_bn_bn_b$
ST	WMO station identifier IIiii
PL	Platform name or other free format text
UU	User specified code (as defined in accompanying plain language record)

TABLE 7B

DATE AND TIME WITHIN DAY

PPPP K MM S

Note: Whenever possible date and time should be expressed in G.M.T. However, if it is necessary to use local time (i.e. zonal time) then the Time Zone must also be provided using the following parameter:-

ZONE 7 XX N TIME ZONE CORRECTION (hours)
Defined as the number of hours to be <u>added</u> to convert the stored date/time parameters to G.M.T.

The definition of all the following parameters in this section are qualified according to entry in MM thus:-

ZT	Time of observation (G.M.T.)
ZS	Time of observation start (G.M.T.)
ZE	Time of observation end (G.M.T.)
LT	Time of observation (local time)
LS	Time of observation start (local time)
LE	Time of observation end (local time)

YEAR 7 -- N CALENDAR YEAR
-- MM as above

MNTH 7 -- N CALENDAR MONTH (MM) WITHIN YEAR
-- MM as above

DATE 7 -- N DATE WITHIN YEAR IN FORMAT MMDD
Where MM = calendar month and DD = day of month
-- MM as above

DAYS 7 -- N DAY NUMBER WITHIN YEAR (Jan 1st = 1)
-- MM as above

TIME 7 -- N TIME WITHIN DAY IN FORMAT HHMMSS
Where HH = hours, MM = minutes and SS = seconds
-- MM as above

HHMM 7 -- N TIME WITHIN DAY IN FORMAT HHMM
Where HH = hours and MM = minutes
-- MM as above

HOUR 7 -- N HOURS WITHIN DAY
-- MM as above

MINS 7 -- N MINUTES WITHIN HOUR
-- MM as above

SECS 7 -- N SECONDS WITHIN MINUTE
-- MM as above

TABLE 7C

TIME AND FREQUENCY

i)

PPPP	K	MM	S	TIME
				Where appropriate the definition of parameters in this section are qualified according to the entry in MM
ETHR	7	XX	N	ELAPSED TIME (HOURS)
ETMN	7	XX	N	ELAPSED TIME (MINUTES)
ETSC	7	XX	N	ELAPSED TIME (SECONDS)
DRHR	7	--	N	DURATION (HOURS)
		PR		Duration of processed observation: total time period over which sampling was undertaken in order to produce the stored observation
		SS		Duration of individual sample: used mainly in cases where the processed observation is itself derived/extracted from a number of discrete individual samples
DRMN	7	--	N	DURATION (MINUTES)
		--		MM as for DRHR
DRSC	7	--	N	DURATION (SECONDS)
		--		MM as for DRHR
NTHR	7	--	N	INTERVAL (HOURS)
		PR		Interval of processed observations - usually the same as data cycle interval
		SS		Original sampling/digitization interval - used mainly in cases where the processed observation may be derived/extracted from higher resolution data
NTMN	7	--	N	INTERVAL (MINUTES)
		--		MM as for NTHR
NTSC	7	--	N	INTERVAL (SECONDS)
		--		MM as for NTHR

ii)

PPPP	K	MM	S	FREQUENCY
FREQ	7	--	N	FREQUENCY (hertz)
		PR		Frequency of processed observations
		SS		Original sampling/digitization frequency
SPCF	7	XX	N	FREQUENCY OF SPECTRAL COMPONENT (hertz)
BAND	7	XX	N	BANDWIDTH OF SPECTRAL ANALYSIS (hertz)
BEST	7	XX	N	BANDWIDTH OF SPECTRAL COMPONENT (hertz) Frequency bandwidth over which the specified spectral component has been estimated - especially where the component is the frequency average of a number of discrete spectral estimates as produced by the original spectral analysis
HIGF	7	XX	N	HIGH FREQUENCY CUT OFF FOR INTEGRATION UNDER SPECTRUM (hertz)
LOWF	7	XX	N	LOW FREQUENCY CUT OFF FOR INTEGRATION UNDER SPECTRUM (hertz)

TABLE 7D

POSITION / NAVIGATION

Parameters in this table are organised under the headings:

- i) GEOGRAPHIC COORDINATES
- ii) RELATIVE COORDINATES
- iii) PLATFORM MOTION/ORIENTATION

i)

PPPP	K	MM	S	GEOGRAPHIC COORDINATES
MAGN	7	XX	N	MAGNETIC VARIATION FROM TRUE NORTH (degrees) east +ve
ALTG	7	XX	N	HEIGHT/ALTITUDE ABOVE GROUND LEVEL (metres) upwards +ve
ALTS	7	XX	N	HEIGHT/ALTITUDE ABOVE MEAN SEA LEVEL (metres) upwards +ve
HGHT	7	XX	N	HEIGHT/ALTITUDE ABOVE SEA SURFACE (metres) upwards +ve
DEPH	7	--	N	SENSOR DEPTH BELOW SEA SURFACE (metres) downwards +ve
		PR		Pressure measurement
		RT		Reversing thermometer
		ES		Echo sounding
		WL		Wire length
		FX		Fixed (e.g. attached to tower or ship hull)
		ID		Standard depth for interpolated data
		BT		Determined from fall rate
		XX		Unspecified
HTSF	7	XX	N	HEIGHT ABOVE SEA FLOOR (metres) upwards +ve
DPSF	7	XX	N	DEPTH BELOW SEA FLOOR (metres) downwards +ve
LATD	7	--	N	LATITUDE DEGREES (North +ve, South -ve)
		--		MM - see parameter MMFX
LATM	7	--	N	LATITUDE MINUTES WITHIN DEGREE (North +ve, South -ve)
		--		MM - see parameter MMFX
LOND	7	--	N	LONGITUDE DEGREES (East +ve, West -ve)
		--		MM - see parameter MMFX
LONM	7	--	N	LONGITUDE MINUTES WITHIN DEGREE (East +ve, West -ve)
		--		MM - see parameter MMFX

Note: It is possible, by use of scale factors or the Fortran format, to use either one parameter (e.g. LATD) with a decimal fraction, or two parameters (e.g. LATD and LATM) with a decimal fraction in LATM or LONM. In the latter case the sign of the latitude or longitude should be attached to both degrees and minutes

PPPP K MM S

MMFX 7 XX N METHOD CODE FOR POSITION FIXING

Two character code to identify the method used for position fixing - coded as below.

(Note that this code may also be used as the method code for parameters LATD, LATM, LOND, LONM if it is appropriate to predefine the method of fixing within the definition record itself - the parameter MMFX is used as an alternative to the parameter MMMM)

CL	Celestial (star fix, sun line)
NS	Satellite Navigation
OM	Omega
LA	Loran A
RC	Loran C
EE	Decca
MD	Mid-range navigational net (approx. 200-500 km e.g. Raydist, Lorac, EPI)
SH	Short-range navigational net (less than 200 km e.g. Hi-Fix, Shoran, Autotape, Hydrodist)
AU	Acoustic (Sofar, sonar, sea floor mounted transducers etc)
BB	Radar
DR	Dead Reckoning
XX	Unspecified

FIXF 7 -- N PRIME NAVIGATION AID FIX FLAG

Flag to indicate whether the position of the measurement point was obtained directly as the result of a fix from the prime navigation aid. This parameter is used primarily with underway measurements in order to highlight the occurrence of fixes. The method code indicates the code table in use:

AA One character flag set to 'F' if position is a primary navaid position fix; otherwise left blank

The following 3 parameters describe an "error ellipse" associated with navigational fix data. Until such time as standard methods are in use, the method by which the ellipse was determined, and the confidence level associated with the ellipse, should be clearly described in plain language records accompanying the data.

EMAJ 7 XX N LENGTH OF SEMI-MAJOR AXIS OF NAVIGATION ERROR ELLIPSE (metres)

EMIN 7 XX N LENGTH OF SEMI-MINOR AXIS OF NAVIGATION ERROR ELLIPSE (metres)

EAZM 7 XX N AZIMUTH OF MAJOR AXIS OF NAVIGATION ERROR ELLIPSE

(degrees, relative to True North)

East of True North +ve

ii) PPPP K MM S **RELATIVE COORDINATES**

ATRK 7 XX N ALONG TRACK DISPLACEMENT (metres, astern +ve)

Horizontal along track displacement of measurement point (e.g. towed sensor) behind moving platform (e.g. ship or aircraft)

XTRK 7 XX N ACROSS TRACK DISPLACEMENT (metres, starboard +ve)

Horizontal cross track (i.e. at right angles to track) displacement of measurement point from moving platform (e.g. ship or aircraft) - starboard +ve, port -ve

Note: For the following parameters the object and the reference point should be clearly identified in the plain language records accompanying the data and the geographic coordinates of one or the other should be specified.

PPPP	K	MM	S	
DIRT	7	XX	N	BEARING OF OBJECT FROM REFERENCE POINT (degrees True) Direction relative to True North: east of north +ve
DIRM	7	XX	N	BEARING OF OBJECT FROM REFERENCE POINT (degrees Magnetic) Direction relative to Magnetic North: east of north +ve
ELEV	7	XX	N	ELEVATION ANGLE OF OBJECT FROM REFERENCE POINT (degrees) Angular elevation of the object above the horizon of the reference point
ZNTH	7	XX	N	ZENITH ANGLE OF OBJECT FROM REFERENCE POINT (degrees) Zenith angle of the object as viewed from the reference point
RADD	7	XX	N	HORIZONTAL DISTANCE OF OBJECT FROM REFERENCE POINT (metres)
RANG	7	XX	N	DIRECT DISTANCE OF OBJECT FROM REFERENCE POINT (metres) i.e. slant range in X,Y,Z coordinates
VERT	7	XX	N	VERTICAL DISTANCE OF OBJECT ABOVE REFERENCE POINT (metres)
DISE	7	XX	N	DISTANCE OF OBJECT IN DIRECTION TRUE EAST FROM REFERENCE POINT (metres) east +ve
DISN	7	XX	N	DISTANCE OF OBJECT IN DIRECTION TRUE NORTH FROM REFERENCE POINT (metres) north +ve

iii) PPPP K MM S PLATFORM MOTION/ORIENTATION

SPDG	7	XX	N	TRUE PLATFORM SPEED ACROSS THE GROUND (metres/second)
SPDR	7	XX	N	RELATIVE PLATFORM SPEED THROUGH THE AIR/WATER (metres/second)
SPDI	7	XX	N	INDICATED PLATFORM SPEED (AIRCRAFT) (metres/second)
SPDV	7	XX	N	VERTICAL PLATFORM SPEED (metres/second) upwards +ve
HEAD	7	XX	N	PLATFORM HEADING (degrees, relative to True North) east +ve Direction in which moving platform (e.g. ship or aircraft) is heading; or orientation of a semi stationary platform (e.g. moored buoy)
PTCH	7	XX	N	PITCH ANGLE (degrees)
ROLL	7	XX	N	ROLL ANGLE (degrees)
ATCK	7	XX	N	ANGLE OF ATTACK (AIRCRAFT) (degrees)
SIDE	7	XX	N	ANGLE OF SIDESLIP (AIRCRAFT) (degrees)

TABLE 7F

WAVES

Introduction

This section contains the most commonly measured wave parameters and includes a precise definition of each. Where the user's parameter does not accord with these definitions, the user is encouraged to define his own parameter code together with its definition, as described at the beginning of Table 7.

A crest is an event where the water surface has zero slope, is preceded by a positive slope and followed by a negative slope. A trough is an event where the water has zero slope, is preceded by a negative slope and followed by a positive slope.

The interpretation of many of the parameters in this section is dependent on the record length i.e. the period of time over which the passage of waves is observed, and in such cases this period should also be stored with the data e.g. as parameter DRSC7PRN (see Table 7C).

The definition of mean record level which is of importance in the zero crossing type of analysis, is not concise when significant variation in water surface elevation is caused by the tide within the duration of the record. Floating buoys tend to filter out this long period movement whereas staff gauges do not. A "zero crossing" is to be understood as the crossing of the mean record level by the water surface at that instant (after filtering tide effects).

The zero crossing crest (trough) amplitude is the maximum vertical distance between the mean record level and the maximum (minimum) level that occurred between an upward (downward) and a following downward (upward) going zero crossing. Both quantities are always positive.

Method Code

Unless defined otherwise, the first character of the method code describes the method for calculating the parameter as follows:-

MM	
X-	unspecified
F-	Fourier Transform (and Integration where appropriate)
L-	Lag correlation analysis
C-	Simple computer analysis of record
M-	Manual analysis of chart record
E-	Visual estimation

The second character describes the sensor used thus:-

MM	
-X	unspecified
-U	Unspecified - instrumental measurement
-A	Accelerometer buoy
-B	Shipborne wave recorder
-E	Inverted echo-sounder
-L	Laser altimeter
-P	Bottom mounted pressure device
-R	Satellite altimeter
-S	Staff gauge
-V	Visual

The parameters in this table are organised under the following headings:

- i) ESTIMATES OF WAVE HEIGHT, PERIOD AND DIRECTION
- ii) WAVE HEIGHT
- iii) WAVE PERIOD
- iv) INSTANTANEOUS SURFACE MEASUREMENTS
- v) WAVE SPECTRA
- vi) DIRECTIONAL WAVE SPECTRA

i) PPPP K MM S ESTIMATES OF WAVE HEIGHT, PERIOD AND DIRECTION

This section covers parameters based on simple estimates of wave conditions either by visual observation (MM = 'EV') or by visual estimation with instrumental aid (MM = 'EU')

SEAS 7 XX D SEA STATE (WMO CODE 3700)
One character code describing wave roughness - coded as in WMO Code Table 3700 - see Annex X

VEST 7 -- D VISUAL AVERAGE WAVE HEIGHT (metres) : H_v
Significant wave height as estimated by visual means

VPER 7 -- D VISUAL ESTIMATE OF WAVE PERIOD (seconds)
Visual estimate of the period between successive waves

VDIR 7 -- D VISUAL ESTIMATE OF DIRECTION FROM WHICH WAVES ARE COMING (degrees, relative to True North)
Visual estimate of the direction from which the dominant waves are coming - east of True North +ve

SWDR 7 -- D DIRECTION FROM WHICH SWELL IS COMING (degrees, relative to True North)
East of True North +ve

SWHT 7 -- D SWELL HEIGHT (metres)
Height of dominant swell above still water level

SWPR 7 -- D SWELL PERIOD (seconds)
Period between successive swell maxima

ii) PPPP K MM S WAVE HEIGHT

WMDP 7 -- D MEAN WATER DEPTH (metres) : Z_1
Vertical distance between mean water level (i.e. average water surface over a period of at least one year) and the sea floor - always positive

WSDP 7 -- D STILL WATER DEPTH (metres) : Z_2
Vertical distance between still water level (i.e. level of water surface in the absence of wave activity) and the sea floor - always positive

WRDP 7 -- D MEAN RECORD WATER DEPTH (metres) : Z_3
Vertical distance between mean record level (average water surface over the period of observation e.g. 20 minutes) and the sea floor - always positive

VMXL 7 -- D MAXIMUM WAVE LEVEL (metres) : Y_1
Maximum zero crossing crest amplitude observed in a record - always positive (= maximum crest amplitude)

VMNL 7 -- D MINIMUM WAVE LEVEL (metres) : Y_z

Maximum zero crossing trough amplitude observed in a record - always positive (= maximum trough amplitude)

VTKC 7 -- D SECOND HIGHEST WAVE CREST (metres)

Second highest crest amplitude observed in a record - always positive

VTKD 7 -- D SECOND LOWEST WAVE TROUGH (metres)

Second highest trough amplitude observed in a record - always positive

VCMX 7 -- D MAXIMUM CREST TO TROUGH WAVE HEIGHT (metres) : $H_{c,max}$

Maximum H_c as observed in a specified period of time, which should always be stated, where H_c is the vertical distance between a crest and the immediately preceding (or following) trough. Within a given data set H_c should refer consistently to either preceding or following troughs but not to both - the convention used should be stated clearly

VZMX 7 -- D MAXIMUM ZERO CROSSING WAVE HEIGHT (metres) : $H_{z,max}$

Maximum H_z as observed in a specified period of time, which should always be stated, where H_z is the sum of the zero crossing crest amplitude and the immediately preceding (or following) zero crossing trough amplitude (both quantities being positive). Within a given data set H_z should refer consistently to either preceding or following zero crossing troughs but not to both - the convention used should be stated clearly

VAVH 7 -- D AVERAGE HEIGHT HIGHEST ONE THIRD WAVES (metres) : $H_{z,1/3}$

Average of the highest one third of the zero up-crossing (or down-crossing according to convention used) wave heights for a stated period of time

VTDH 7 -- D TUCKER DRAPER SIGNIFICANT WAVE HEIGHT (metres)

Significant wave height as estimated by the Tucker Draper method (Draper.L. Proc. Instn. Civ. Engrs. 26, 291-304 (1963) for a stated period of time

VRMS 7 -- D RMS WAVE DISPLACEMENT (metres) : H_{RMS}

Square root of the variance, i.e. the square root of the average square displacement of the water surface from the mean record level

VCAR 7 -- D CHARACTERISTIC WAVE HEIGHT (metres) : H_{mo}

Wave height parameter as computed from the RMS value of the record i.e. $4*H_{RMS}$ for a stated period of time

iii) PPPP K MM S **WAVE PERIOD**

VTZM 7 -- D PERIOD OF MAXIMUM ZERO CROSSING WAVE (seconds) : $T_{Hz,max}$

Interval between the two upward (or downward according to the convention adopted for VZMX) zero crossings defining the maximum zero crossing wave height wave

VTZA 7 -- D AVERAGE ZERO CROSSING WAVE PERIOD (seconds) : $\overline{T}_z$

Average of the zero crossing intervals as obtained by dividing the record duration by the number of times the water elevation crosses the mean record level in one direction

VTCA 7 -- D AVERAGE WAVE CREST PERIOD (seconds) : $\overline{T}_c$

Time obtained by dividing the record duration by the total number of crests in the record

VBRF 7 -- D WAVES SPECTRAL WIDTH (BROADNESS)
Defined as equal to $(1 - (\overline{T}_c/\overline{T}_z)^2)^{1/2}$

iv) PPPP K MM S INSTANTANEOUS SURFACE MEASUREMENTS

VWSE 7 -- D INSTANTANEOUS WATER SURFACE ELEVATION (metres)
Instantaneous water surface elevation relative to some arbitrary mean - positive upwards
Processing carried out on data:
X- unspecified
F- digital filter has been used
A- analogue filter has been used
(Second character of MM as for other wave parameters i.e. sensor type)

VWSA 7 -- D INSTANTANEOUS HEAVE ACCELERATION (metres/second^2)
-- MM as for VWSE

VWTE 7 -- D WATER SURFACE EAST-WEST TILT ANGLE (degrees)
Instantaneous water surface tilt in the east-west (true) vertical plane - measured relative to the horizontal, east upwards positive
-- MM as for VWSE

VWTN 7 -- D WATER SURFACE NORTH-SOUTH TILT ANGLE (degrees)
Instantaneous water surface tilt in the north-south (true) vertical plane - measured relative to the horizontal, north upwards positive
-- MM as for VWSE

v) PPPP K MM S WAVE SPECTRA

VSDN 7 -- D WAVE VARIANCE SPECTRAL DENSITY (metres^2/hertz) : S(f)
Estimate of the spectral density of the variance of the water surface elevation at a specified frequency (as specified in associated parameter SPCF7XXN - see Table 7C)

VTPK 7 -- D WAVE SPECTRUM PEAK PERIOD (seconds) : T_p
Inverse of the frequency at which the maximum variance spectral density occurs

MOMENTS OF THE VARIANCE SPECTRAL DENSITY
The n'th moment m_n of the variance spectral density function is defined as the integral of $f^nS(f)df$ (limits of integration being defined in parameters LOWF7XXN and HIGF7XXN - see Table 7C):

VMTA 7 -- D ZEROETH MOMENT OF WAVE SPECTRUM (metres^2) : m_o

VMTB 7 -- D FIRST MOMENT OF WAVE SPECTRUM (metres^2.hertz) : m_1

VMTC 7 -- D SECOND MOMENT OF WAVE SPECTRUM (metres^2.hertz^2) : m_2

VMTD 7 -- D THIRD MOMENT OF WAVE SPECTRUM (metres^2.hertz^3) : m_3

VMTE 7 -- D FOURTH MOMENT OF WAVE SPECTRUM (metres^2.hertz^4) : m_4

VMTM 7 -- D FIRST NEGATIVE MOMENT OF WAVE SPECTRUM (metres^2/hertz) : m_{-1}

VMTN 7 -- D SECOND NEGATIVE MOMENT OF WAVE SPECTRUM (metres^2/hertz^2) : m_{-2}

PPPP K MM S

VSWD 7 -- D WAVES SPECTRAL WIDTH FROM MOMENTS
Spectral width from moments of the spectrum defined as equal to

$$\frac{(m_0.m_4 - m_2{}^2)^{1/2}}{(m_0.m_4)^{1/2}}$$

VSMA 7 -- D SPECTRAL MOMENTS (-1,0) WAVE PERIOD (seconds) : $Tm_{-1,0}$
Where $Tm_{-1,0} = m_{-1}/m_0$

VSMB 7 -- D SPECTRAL MOMENTS (0,1) WAVE PERIOD (seconds) : $Tm_{0,1}$
Where $Tm_{0,1} = m_0/m_1$

VSMC 7 -- D SPECTRAL MOMENTS (0,2) WAVE PERIOD (seconds) : $Tm_{0,2}$
Where $Tm_{0,2} = (m_0/m_2)^{1/2}$
(sometimes referred to as average apparent period)

VSMD 7 -- D SPECTRAL MOMENTS (2,4) WAVE PERIOD (seconds) : $Tm_{2,4}$
Where $Tm_{2,4} = (m_2/m_4)^{1/2}$

vi) PPPP K MM S DIRECTIONAL WAVE SPECTRA

The following eight parameters represent the spectral components estimated at a specified frequency, f (as specified in associated parameter SPCF7XXN - see Table 7C), from the cross spectral analysis of instantaneous measurements of heave, east-west tilt and north-south tilt. The following conventions are adopted:

heave	- water surface elevation in metres relative to an arbitrary mean, positive upwards
east-west tilt -	water surface tilt in degrees in the east-west (true) vertical plane; measured relative to the horizontal, east upwards positive
north-south tilt -	water surface tilt in degrees in the north-south (true) vertical plane; measured relative to the horizontal, north upwards positive

Note that the auto-spectrum of heave ($C_{11}(f)$) is given by parameter VSDN 7 -- D in the previous section

VCXX 7 -- D AUTO-SPECTRUM OF NORTH-SOUTH TILT (degrees²/hertz): $C_{22}(f)$

VCYY 7 -- D AUTO-SPECTRUM OF EAST-WEST TILT (degrees²/hertz): $C_{33}(f)$

VQZX 7 -- D QUAD-SPECTRUM OF HEAVE AND NORTH-SOUTH TILT (metre.degrees/hertz): $Q_{12}(f)$

VQZY 7 -- D QUAD-SPECTRUM OF HEAVE AND EAST-WEST TILT (metre.degrees/hertz): $Q_{13}(f)$

VQXY 7 -- D QUAD-SPECTRUM OF NORTH-SOUTH AND EAST-WEST TILTS (degrees²/hertz): $Q_{23}(f)$

VCZX 7 -- D CO-SPECTRUM OF HEAVE AND NORTH-SOUTH TILT (metre.degrees/hertz): $C_{12}(f)$

VCZY 7 -- D CO-SPECTRUM OF HEAVE AND EAST-WEST TILT (metre.degrees/hertz): $C_{13}(f)$

VCXY 7 -- D CO-SPECTRUM OF NORTH-SOUTH AND EAST-WEST TILTS (degrees²/hertz): $C_{23}(f)$

The following three parameters may be derived from the above cross spectral components (see e.g. Longuet-Higgins et al (1963), 'Observations of the directional spectrum of sea waves using the motions of a floating buoy' in Ocean Wave Spectra, pp 111-132, Prentice-Hall, Englewood Cliffs):

PPPP	K	MM	S	
VNUM	7	--	D	WAVE NUMBER FROM CROSS SPECTRA (degrees/metre): k(f) where $k(f) = \text{sq.rt. } ((C_{22}+C_{33})/C_{11})$
VMWD	7	--	D	MEAN WAVE DIRECTION FROM CROSS SPECTRA (degrees): $\theta_1(f)$ where $\theta_1(f) = \text{arc tan } (Q_{13}/Q_{12})$ gives the mean direction, relative to true North, from which the waves are coming (on the assumption that the directional distribution is unimodal) and is based on the first angular harmonics of the directional spectrum at the specified frequency
VSPR	7	--	D	WAVE DIRECTIONAL SPREAD FROM CROSS SPECTRA (degrees): $\theta_2(f)$ where $\theta_2(f) = \text{sq.rt. } (2\text{-}2C)$ in which $C = \text{sq.rt. } ((Q_{12}^2+Q_{13}^2)/(C_{11}(C_{22}+C_{33})))$ For a narrow directional distribution, $\theta_2(f)$ gives the rms spread about the mean wave direction and is based on the first order angular harmonics of the directional spectrum
VDSD	7	--	D	DIRECTIONAL WAVE SPECTRUM DENSITY (metres^2/hertz):S(f,θ) Spectral density of the variance of the water surface elevation at a specified frequency, f, due to waves coming from a specified direction, θ, within a band of width, Δθ, where f is specified in associated parameter SPCF (see Table 7C) θ is specified in associated parameter VDEP (see below) Δθ is specified in associated parameter BDIR (see below)
VDEP	7	XX	N	SPECIFIED DIRECTION OF WAVE ENERGY PROPAGATION (degrees) Used for identifying a specific directional component of a directional wave spectrum. Expressed relative to true North in the direction from which the waves are coming
BDIR	7	XX	N	BANDWIDTH OF DIRECTIONAL ANALYSIS (degrees) Directional bandwidth of directional spectrum analysis
VPED	7	--	D	WAVE SPECTRUM PEAK ENERGY DIRECTION (degrees) Direction of wave propagation at the frequency of the maximum variance density. Measured relative to true North in the direction from which waves are coming
VMED	7	--	D	WAVE SPECTRUM MEAN ENERGY DIRECTION (degrees) Within each frequency band a vector is defined having the magnitude of the wave energy within the band and the direction of the peak energy of the waves in the band. The mean energy direction is the direction of the resultant of the sum of these vectors over all frequency bands

TABLE 7G

METEOROLOGY

Parameters in this table are organised under the headings:

- i) CLOUD, WEATHER, VISIBILITY AND RAIN
- ii) PRESSURE AND HUMIDITY
- iii) WIND
- iv) TEMPERATURE
- v) RADIATION
- vi) FLUCTUATIONS IN WIND SPEED, TEMPERATURE AND HUMIDITY

i) **PPPP K MM S** CLOUD, WEATHER, VISIBILITY AND RAIN

CCVR 7 XX A	TOTAL CLOUD COVER IN TENTHS OF SKY (tenths)
CLDA 7 XX A	TOTAL CLOUD AMOUNT (OKTAS-WMO CODE 2700) One character code for total cloud cover in oktas of sky - coded as in WMO Code Table 2700 - see Annex X (note: set as blank if not estimated, set to '9' if sky obscured or cloud amount cannot be estimated)
CLCM 7 XX A	AMOUNT OF LOW/MEDIUM ALTITUDE CLOUD (OKTAS - WMO CODE 2700) One character code for the amount of all low level cloud (C_L) present or, if no C_L cloud is present, the amount of all the medium level cloud (C_M) present - coded as in WMO Code Table 2700 - see Annex X
CLDB 7 XX A	CLOUD BASE ALTITUDE (metres) Height above ground or sea surface
CLDH 7 XX A	CLOUD BASE HEIGHT (WMO CODE 1600) One character code for the height above ground or sea surface of the base of the lowest cloud seen - coded as in WMO Code Table 1600 - see Annex X
CLDT 7 XX A	CLOUD TYPE (WMO CODE 0500) One character code for the genus of the dominant cloud type - coded as in WMO Code Table 0500 - see Annex X
CLCL 7 XX A	TYPE OF LOW ALTITUDE CLOUD (WMO CODE 0513) One character code to describe the clouds of genera Stratocumulus, Stratus, Cumulus and Cumulonimbus - coded as in WMO Code Table 0513 - see Annex X
CMCM 7 XX A	TYPE OF MEDIUM ALTITUDE CLOUD (WMO CODE 0515) One character code to describe the clouds of genera Altocumulus, Altostratus and Nimbostratus - coded as in WMO Code Table 0515 - see Annex X
CHCH 7 XX A	TYPE OF HIGH ALTITUDE CLOUD (WMO CODE 0509) One character code to describe the clouds of genera Cirrus, Cirrocumulus and Cirrostratus - coded as in WMO Code Table 0509 - see Annex X
WWCD 7 XX A	PRESENT WEATHER (WMO CODE 4677) Two character code to describe the present weather - coded as in WMO Code Table 4677 - see Annex X

WTHA 7 XX A	PAST WEATHER (WMO CODE 4561) One character code to describe recent/past weather - coded as in WMO Code Table 4561 - see Annex X
VISB 7 XX A	HORIZONTAL VISIBILITY (metres)
PRTN 7 XX A	PRECIPITATION AMOUNT (millimetres) Rainfall amount in a specified period (specified in associated parameter DRHR7PRN - see Table 7C)
PRRT 7 XX A	PRECIPITATION RATE (millimetres/hour)

ii) **PPPP K MM S** PRESSURE AND HUMIDITY

ATMS 7 XX A	ATMOSPHERIC PRESSURE AT SEA LEVEL (hectopascals = millibars) Note: either measured at sea level or reduced to mean sea level
ATMP 7 XX A	ATMOSPHERIC PRESSURE AT ALTITUDE (hectopascals)
ATPT 7 XX A	ATMOSPHERIC PRESSURE TENDENCY (hectopascals/hour) (rising +ve, falling -ve)
VAPP 7 XX A	ACTUAL WATER VAPOUR PRESSURE (hectopascals)
ABSH 7 XX A	ABSOLUTE HUMIDITY (grams/cubic metre)
SPEH 7 XX A	SPECIFIC HUMIDITY (grams/kilogram)
RELH 7 XX A	RELATIVE HUMIDITY (percent)
HMXR 7 XX A	HUMIDITY MIXING RATIO (grams/kilogram) also called mass mixing ratio
LWCT 7 XX A	LIQUID WATER CONTENT (grams/cubic metre)
TWCT 7 XX A	TOTAL WATER CONTENT (grams/cubic metre)

iii) **PPPP K MM S** WIND

WSPD 7 XX A	HORIZONTAL WIND SPEED (metres/second)
WDIR 7 XX A	DIRECTION FROM WHICH WIND IS BLOWING (degrees relative to True North)
GSPD 7 XX A	GUST WIND SPEED (metres/second)
GDIR 7 XX A	DIRECTION FROM WHICH GUST WIND IS BLOWING (degrees relative to True North)
WFBS 7 XX A	WIND FORCE ON BEAUFORT SCALE Two digit Beaufort Scale - see e.g. Manual on Codes (WMO - No. 306)
WSPE 7 XX A	EASTWARD (TRUE) COMPONENT OF WIND SPEED (metres/second): U (+ve towards east)

WSPN 7 XX A NORTHWARD (TRUE) COMPONENT OF WIND SPEED (metres/second): V
(+ve towards north)

VWSH 7 XX A VERTICAL WIND SHEAR (metres/second per kilometre)
Vertical gradient of the horizontal wind speed - positive for wind speed increasing upwards

WVER 7 XX A VERTICAL WIND SPEED (metres/second)
(+ve upwards)

iv) PPPP K MM S TEMPERATURE

DRYT 7 XX A DRY BULB TEMPERATURE (degrees Celsius)

WETT 7 XX A WET BULB TEMPERATURE (degrees Celsius)

DEWT 7 XX A DEW POINT TEMPERATURE (degrees Celsius)

DEWD 7 XX A DEW POINT DEPRESSION (degrees Celsius)

SOLT 7 XX G GROUND (SOIL) TEMPERATURE (degrees Celsius)

STAG 7 XX A STAGNATION TEMPERATURE (degrees Celsius)

VIRT 7 XX A VIRTUAL AIR TEMPERATURE (degrees Celsius)

POTT 7 XX A POTENTIAL AIR TEMPERATURE (degrees Celsius)

BRIT 7 XX A BRIGHTNESS (RADIATIVE) TEMPERATURE (degrees Celsius)

DTDZ 7 -- A VERTICAL AIR TEMPERATURE GRADIENT (degrees Celsius/metre)
Negative for temperature decreasing upwards - parameter is qualified by the entry in MM thus
DB Dry bulb temperature
EP Dew point temperature
WB Wet bulb temperature
VT Virtual temperature
PT Potential temperature

TDIF 7 -- A AIR TEMPERATURE DIFFERENCE BETWEEN TWO LEVELS (UPPER-LOWER) (degrees Celsius)
Parameter is qualified by the entry in MM thus:
-- MM as for DTDZ

ASTD 7 XX B AIR-SEA TEMPERATURE DIFFERENCE (degrees Celsius)
Dry bulb temperature minus sea surface temperature

v) PPPP K MM S RADIATION

SDIR 7 XX A SHORT-WAVE DIRECT RADIATION (watts/square metre)

SDIF 7 XX A SHORT-WAVE DIFFUSE RADIATION (watts/square metre)

SINC 7 XX A SHORT-WAVE INCOMING RADIATION (watts/square metre)

SOUT 7 XX A	SHORT-WAVE OUTGOING RADIATION (watts/square metre)
LINC 7 XX A	LONG-WAVE INCOMING RADIATION (watts/square metre)
LOUT 7 XX A	LONG-WAVE OUTGOING RADIATION (watts/square metre)
NETR 7 XX A	NET RADIATION (watts/square metre)
ULTR 7 XX A	ULTRA-VIOLET RADIATION (watts/square metre)
NIRR 7 XX A	NEAR-INFRARED RADIATION (watts/square metre)
QSOL 7 XX G	GROUND HEAT FLUX (watts/square metre)

vi) PPPP K MM S FLUCTUATIONS IN WIND SPEED, TEMPERATURE AND HUMIDITY

SDWS 7 -- A	STANDARD DEVIATION OF WIND SPEED (metres/second)
	Parameter is qualified by the entry in MM thus:
HH	Horizontal wind speed
UU	Eastwards component of wind speed
VV	Northwards component of wind speed
WW	Vertical wind speed
VRWS 7 -- A	VARIANCE OF WIND SPEED (metres/second)^2
	Parameter is qualified by the entry in MM
--	MM as for SDWS
SDAT 7 -- A	STANDARD DEVIATION OF AIR TEMPERATURE (degrees Celsius)
	Parameter is qualified by the entry in MM thus:
DB	Dry bulb temperature
RT	Virtual temperature
PT	Potential temperature
VRAT 7 -- A	VARIANCE OF AIR TEMPERATURE (degrees Celsius)^2
	Parameter is qualified by the entry in MM
--	MM as for SDAT
SDHU 7 XX A	STANDARD DEVIATION OF SPECIFIC HUMIDITY (grams/kilogram)
VRHU 7 XX A	VARIANCE OF SPECIFIC HUMIDITY (grams/kilogram)^2
CVWS 7 -- A	CO-VARIANCE OF WIND SPEED COMPONENTS (metres/second)^2
	Co-variance of the fluctuations of wind speed components around their mean values. The components are identified by the entry in MM thus:
UV	Co-variance of components U and V
UW	Co-variance of components U and W
VW	Co-variance of components V and W

where U = eastward component of wind speed (+ve towards east)
V = northward component of wind speed (+ve towards north)
W = vertical component of wind speed (+ve upwards)

PPPP K MM S

CVWT 7 -- A CO-VARIANCE OF WIND SPEED AND AIR TEMPERATURE (degC.m/s)
Co-variance of the fluctuations of wind speed component and air temperature around their mean values. The wind speed component and temperature measurement are identified by the entry in MM.

1st character of MM specifies the wind speed component thus:

H-	horizontal component of wind speed
U-	eastward component of wind speed (+ve towards east)
V-	northward component of wind speed (+ve towards north)
W-	vertical component of wind speed (+ve upwards)

2nd character of MM qualifies the temperature thus:

-D	dry bulb temperature
-R	virtual temperature
-P	potential temperature

CVWQ 7 -- A CO-VARIANCE OF WIND SPEED AND SPECIFIC HUMIDITY (m/s).g/kg
Co-variance of the fluctuations of wind speed component and specific humidity around their mean values. The wind speed component is identified by the entry in MM thus:

-Q	1st character of MM specifies the wind speed component and is coded as for 1st character of MM in parameter CVWT

CVTQ 7 -- A CO-VARIANCE OF AIR TEMPERATURE AND SPECIFIC HUMIDITY (degC.g/kg)
Co-variance of the fluctuations of air temperature and specific humidity around their mean values. The temperature measurement is identified by the entry in MM thus:

DQ	co-variance of dry bulb temperature and specific humidity
RQ	co-variance of virtual temperature and specific humidity
PQ	co-variance of potential temperature and specific humidity