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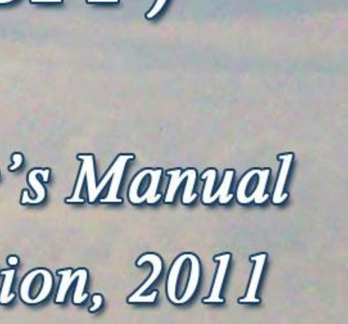
Global Temperature and Salinity Profile Programme (GTSPP)

Data User's Manual
First Edition, 2011



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APPENDICES

1. INTRODUCTION

1.1. About GTSPP

The Global Temperature and Salinity Profile Programme (GTSPP) is a joint Intergovernmental Oceanographic Commission (IOC) and World Meteorological Organization (WMO) programme to develop and maintain a global ocean Temperature-Salinity resource with data that are both up-to-date and of the highest quality[2]. The four primary objectives of GTSPP are:

a) Provide a timely and complete data and information base of ocean temperature and salinity profile data,

b) Implement data flow monitoring system for improving the capture and timeliness of real-time and delayed-mode data,

c) Improve and implement agreed and uniform quality control and duplicates management systems, and

d) Facilitate the development and provision of a wide variety of useful data analyses, data and information products, and data sets.

The international oceanographic community's interest in creating a timely global ocean temperature and salinity dataset of known quality in support of the World Climate Research Programme (WCRP) dates back to the 1981 "International Oceanographic Data and Information Exchange" (IODE) meeting in Hamburg, Federal Republic of Germany. The community's interest led to preliminary discussions by the Australian Oceanographic Data Center (AODC), the Marine Environmental Data Service (MEDS), now the Integrated Science Data Management (ISDM), of Canada and the U.S. National Oceanographic Data Center (NODC) during the second Joint IOC–WMO Meeting of Experts on IGOSS[1]-IODE Data Flow in Ottawa, Canada in January 1988.

Development of the GTSPP (then called the Global Temperature-Salinity Pilot Project) began in 1989. The short-term goal was to respond to the needs of the Tropical Ocean and Global Atmosphere (TOGA) Experiment and the World Ocean Circulation Experiment (WOCE) for temperature and salinity data. The longer-term goal was to develop and implement an end-to-end data management system for temperature and salinity data and other associated types of profiles, which could serve as a model for future oceanographic data management systems. GTSPP began operation in November 1990. The first version of the GTSPP Project Plan was published in the same year. Since that time, there have been many developments and some changes in direction including a decision by IOC and WMO to end the pilot phase and implement GTSPP as a permanent programme in 1996.

Figure 1 is a sketch diagramme of the GTSPP management structure. GTSPP reports to the IODE Programme of IOC and the Joint Commission for Oceanography and Marine Meteorology (JCOMM), a body sponsored by WMO and IOC.

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[1] IGOSS is an abbreviation of <u>I</u>ntegrated <u>G</u>lobal <u>O</u>cean <u>S</u>ervices <u>S</u>ystem. IGOSS is now being encompassed within the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology.

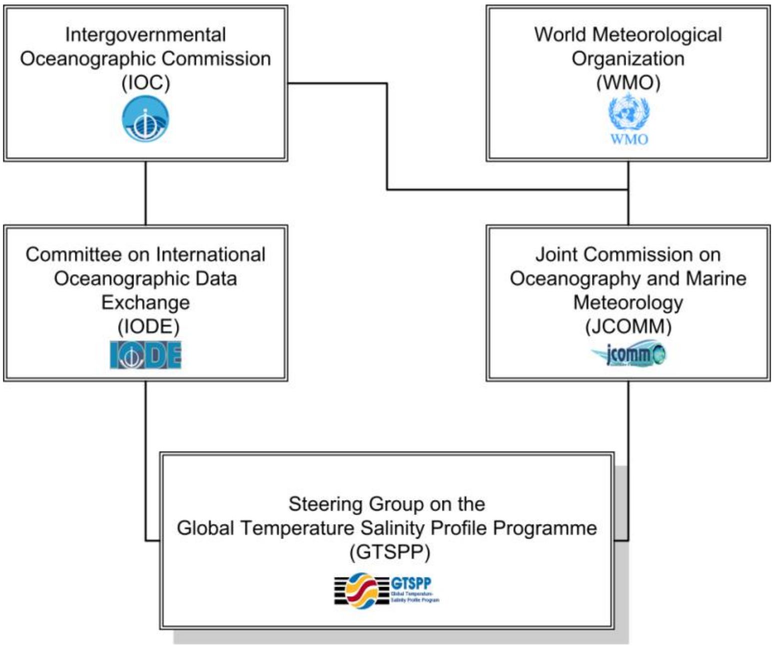


Figure 1. Management of the GTSPP

1.2. About this manual

The main purpose of this manual is to describe the GTSPP data formats that are used to populate GTSPP data for the public use and document the standard conventions used therein. The goal is to provide a format that contains everything necessary to evaluate data quality, data origins and data reliability.

This manual is intended as a standalone document for GTSPP data users to become familiar with the GTSPP data formats. GTSPP populates its data in two formats. The first one is the GTSPP netCDF format, which is the primary focus of this manual, and the other is the GTSPP ASCII format as described in Appendix A of this manual. GTSPP encourages readers of this manual check the GTSPP Website for any undated information of the GTSPP codes described in this manual.

This manual should be cited as “Global Temperature and Salinity Profile Programme (GTSPP) Data User’s Manual, First Edition, 2011, IOC Manuals and Guides 60, 48p.”

1.3. User’s obligation

A user of GTSPP data is expected to read and understand this manual and the documentation about the data as contained in the "attributes" of the NetCDF data files, as these contain essential information about data quality and accuracy. It is the sole responsibility of the user to assess if the data are appropriate for his/her use, and to interpret the data, data quality, and data accuracy accordingly. Users of GTSPP data accept the responsibility of emailing citations of publications of research using GTSPP data to NODC.GTSPP AT noaa.gov. Any redistribution of GTSPP data must include this data citation and acknowledgement statement stated in the “Data Citation and Acknowledgement” section of this manual.

1.4. Data Citation and Acknowledgement

Unless stated otherwise, any use of GTSPP data must acknowledge the contribution of the GTSPP project and GTSPP sponsor agencies in all publications and products where such data are used, preferably with the following standard sentence:

"*This research uses data were collected and made freely available by the international Global Temperature and Salinity Profile Programme (http://www.nodc.noaa.gov/GTSPP/) and the national programs that contribute to it. GTSPP is supported by the International Oceanographic Data and Information Exchange (IODE) programme of the Intergovernmental Oceanographic Commission (IOC) and the Joint Commission for Oceanography and Marine Meteorology (JCOMM)*."

In addition, the words "*Global Temperature and Salinity Profile Programme*" or "*GTSPP*'" should be included as metadata for webpage's referencing work using GTSPP data or as keywords provided to journal or book publishers of your manuscripts.

1.5. Disclaimer

GTSPP data are published without any warranty, express or implied. The user assumes all risk arising from his/her use of GTSPP data. Real time GTSPP data are not fully quality controlled and therefore are more likely to contain erroneous data. Real time data should therefore be used with more caution. Delayed mode GTSPP data are intended to be research-quality and include estimates of data quality and accuracy, but it is possible that these estimates or the data themselves contain errors.

It is the sole responsibility of the user to assess if the data are appropriate for his/her use, and to interpret the data, data quality, and data accuracy accordingly. GTSPP welcomes users to ask questions and report problems to the contact addresses listed in the data files or on the GTSPP Internet page.

2. DATA FLOWS

Figure 2 presents the data flows of national and international programmes within which GTSPP is placed. The boxes in the figure represent generic centres. A given international JCOMM or IODE centre may fit within several boxes in carrying out its national and international responsibilities.

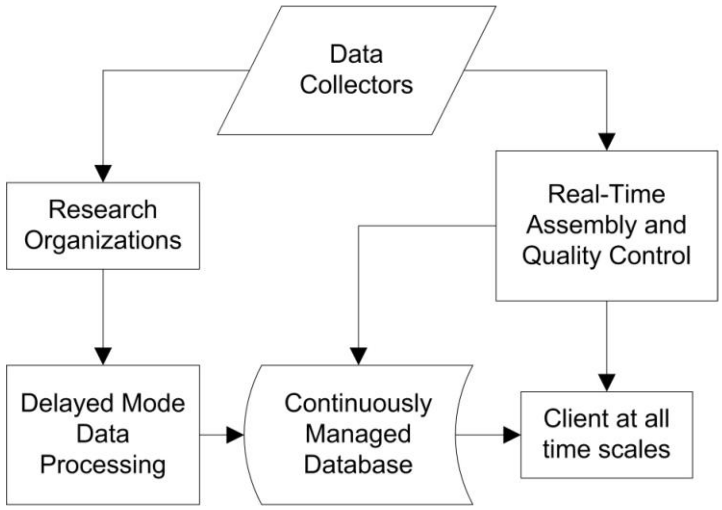


Figure 2. GTSPP Data Flows

The following sections discuss this figure in terms of essential elements of the GTSPP data flows.

2.1. Real-time Data Acquisition

Real time (or near real-time) data acquisition within GTSPP depends on the Global Telecommunications System (GTS) of the World Weather Watch of WMO and the telecommunications arrangements for BATHY and TESAC data established by IGOSS (now JCOMM). Copies of other real time or operational time frame data sets are acquired from any other available sources via the Internet of other computer networks. The goal is to ensure that the most complete operational time frame data set is captured. IGOSS defines real-time to be any data exchanged within 30 days of collection. BATHY permits reporting temperatures to 0.1 degrees C as is most often used for XBT data, TESACs permit reporting both temperature and salinity profiles, both to two decimal places. High resolution data are those that reflect the sampling capabilities of instrumentation. For example, CTD data typically are handled at 1 m resolution and are considered to be high resolution data.

Figure 3 is a graphic representation of the GTSPP operational time frame data flow. The "data collectors" in the top boxes follow one of two procedures. In the first case the data are provided to GTS centres that place them on the GTS within minutes to days of their collection[3]. In the second case the data are supplied to a national organization that forwards them to the real time centre in ISDM within a few days to a month of its collection. The real time data that are circulated on the GTS are acquired by ISDM and the Specialized Oceanographic Centres (SOCs) of JCOMM and by users of real time data who have access to the GTS. These users include meteorological and oceanographic centres that issue forecasts and warnings, centres that provide ship routing services, and centres that prepare real time products for the fishing industry.

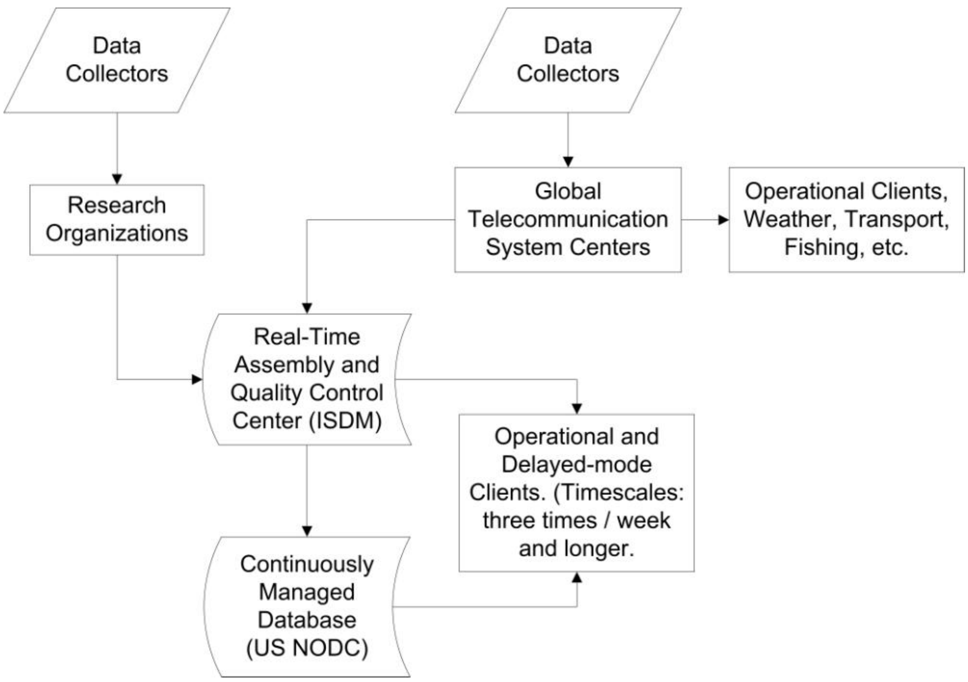


Figure 3. GTSPP Real-time data flow

ISDM compiles the global data set from the various sources, applies the documented GTSPP QC and duplicates removal procedures, and forwards the data to the US NODC three times per week. At NODC the data are added to the GTSPP continuously managed database (CMD) on the same schedule. There are also several clients that receive copies of the data sent from

ISDM three times per week. These are clients who do not need the data within hours but rather within a few days. By getting the data from the GTSPP Centre in ISDM they save having to operate computer systems to do quality control and duplicate removal.

The regular route for real-time data to the box marked "Operational Clients" in Figure 3 is not affected by GTSPP. This route provides for uninterrupted flow of data for weather and operational forecasting through the national weather services of member states. These centres need the data in hours rather than days.

2.2. Delayed-mode Data Acquisition

GTSPP utilizes, to the extent possible, the existing IODE data network and processing system to acquire and process delayed mode data. The box entitled "Delayed Mode & Historical Data" in Figure 4 shows the delayed mode data flow in graphic form. The data flow into the continuously managed database is through a "Delayed Mode QC" process. This process is analogous to the QC carried out on the real-time data and conforms to the specifications of the GTSPP QC Manual[6]. In some cases, where appropriate arrangements can be made this QC process exists and is performed in another oceanographic data centre on behalf of NODC.

Having proceeded through the delayed mode QC process, the data then follow the same route as the real time data through the rest of the CMD process, however, on a different time schedule because of the more irregular times of arrival. During the merging of the data into the CMD, any duplicates occurring between real-time and delayed mode data sources are identified with the highest resolution copy being retained as the active CMD version.

Acquisition of delayed mode data from the Principal Investigators is a priority for the GTSPP. The goal is to get the delayed mode data into the CMD within one year or less of its collection. An excellent way for any national oceanographic data centre to support GTSPP actively is to obtain national data sets of temperature and salinity data, apply GTSPP QC procedures, and submit them to the CMD.

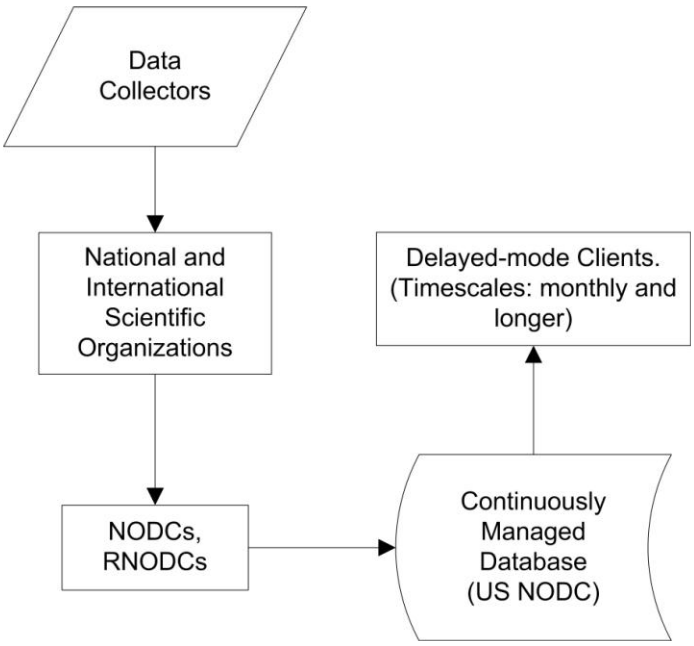


Figure 4. GTSPP Delayed mode data flow

3. DATA QUALITY CONTROL

Quality control of the data in the GTSPP system is handled at a few centres. The ISDM handles near real-time, low-resolution data and applies quality control processing[6] to these data before forwarding them to the NODC. The data handled by GTSPP include all profile data reported through the WMO GTS and so includes data from profiling floats, SOOP, moorings, research cruises that make their data available in real-time, and all other contributors, such as the most recent contributions from instrumented animals. Real-time quality control procedures are a combination of both automated and manual checking. The automated part is substantively the same as used in Argo though tests in the Argo programme that are specifically targeted at known failure modes of profiling floats. The manual component to GTSPP real-time Quality-Control (QC) catches failures not detected automatically, albeit at the expense of adding a couple of days delay in making the data available.

Currently, NODC removes duplicates and utilizes a basic "Delayed Mode Quality-Control (QC)" process analogous to the QC carried out on the real-time data. The quality reviewing procedures generally include three steps: 1) cruise metadata checks; 2) profile data review; and 3) quality control edit. The NODC developed and implemented data quality cruise editor (QCED) software, which performs automatic QC tests and allows an operator to view data from files in the GTSPP-ASCII format (Appendix A). The programme allows the temperature and salinity profiles to be visually inspected and compared with climatology and with neighbouring stations, the position and time metadata to be checked and edited, and profile QC flags to be edited. At the end of the process, data, passed the quality review process, have been loaded into the GTSPP database with its data quality flags. The flags indicating data quality are those currently used in IGOSS processing with one extension. Table 1 describes the GTSPP data quality codes and their meaning.

Table 1. *GTSPP Data Quality Codes*

Code	Meaning
0	No quality control (QC) has been performed on this element.
1	QC has been performed; element appears to be correct.
2	QC has been performed; element appears to be correct but is inconsistent with other elements.
3	QC has been performed; element appears to be doubtful.
4	QC has been performed; element appears to be erroneous.
5	The value has been changed as a result of QC.
6 ~ 8	Reserved for future use.
9	The value of the element is missing.

However, because quality assessment is shared over processing centres, it is possible that data flagged as doubtful by one centre will be considered acceptable by another or vice versa. Flags can be changed by a GTSPP processing centre as long as the original values are preserved and the originators flags can be recovered. This is commonly known as an audit trail. The use of the flagging scheme described meets the stated requirements of the GTSPP. It is recognized that as new testing procedures are developed, it will be necessary to re-examine data. With version flags preserved with the data, it is possible to identify what was done and therefore how best to approach the task of passing data through newer quality control procedures. Typically, results of the QC procedure are the setting of flags or making corrections where data illustrate instrument failures and human errors.

Delayed mode QC in GTSPP has evolved since its inception. During the World Ocean Circulation Experiment (WOCE)[7], three centres, Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), Scripps Institution of Oceanography (SIO) and Atlantic Oceanographic and Meteorological Laboratory (AOML), contributed to Ocean based delayed mode QC with results returned yearly to NODC. Since the end of WOCE, such scientific level QC has lapsed to a large degree. One of the near-term goals of GTSPP will be to revive this scientific QC, thereby making the data served through the project more immediately useful.

4. OVERVIEW OF THE FORMAT

4.1. About netCDF

NetCDF is an abstraction that supports a view of data as a collection of self-describing, network-transparent objects that can be accessed through a simple interface. "Self-describing" means that a file includes information defining the data it contains. "Network-transparent" means that a file is represented in a form that can be accessed by computers with different ways of storing integers, characters, and floating-point numbers. The physical representation of netCDF data is designed to be independent of the computer on which the data were written.

Collections of named multidimensional variables can be randomly accessed, without knowing details of how the data are stored. Auxiliary information about the data, such as what units are used, can be stored with the data. Generic utilities and application programmes can be written that access arbitrary netCDF files and transform, combine, analyze, or display specified fields of the data. Using the netCDF interface may lead to improved accessibility of data and improved reusability of software for scientific data management, analysis, and display.

A netCDF file contains three basic components[4]:

a) *Dimensions*: provide information on the size of the data variables.

b) *Variables*: store the actual data, the dimensions give the relevant dimension information for the variables, and the attributes provide auxiliary information about the variables or the dataset itself. All components have both a name and an ID number by which they are identified. These components can be used together to capture the meaning of data and relations among data fields in an array-oriented dataset; and

c) *Global attributes*: provide information about the data set as an entity. These attributes provide information about the spatial and temporal coverage of the data, where the data came from, who produced the data, and what has been done to them.

The GTSPP NetCDF format described here will continue to evolve as new data types and sources come on line (e.g., animal sensors). But with this starting point, we can ensure that data is collected, described and distributed in a consistent way that makes it easier for users to ingest this data. Metadata is a fundamental part of this process and we have made every effort to provide space for all metadata that can be associated with a data source, be it animal sensors or XBTs. We stress that it is in the best interests of all users if the data providers supply complete metadata with every profile submitted to the GTSPP Global Data Assembly Centre (GDAC).

4.2. GTSPP NetCDF Format Components

GTSPP generalized the Cooperative Ocean/Atmosphere Research Data Service (COARDS)[1] and World Ocean Circulation Experiment (WOCE)[8] netCDF conventions and extended the conventions recommended by the Climate Forecast (CF) metadata (http://cf-pcmdi.llnl.gov/) and Attribute Conventions for Dataset Discovery (ACDD) projects wherever applicable. (http://www.unidata.ucar.edu/software/netcdf-java/formats/DataDiscoveryAttConvention.html). However, sometime, it is advisable to maintain backward compatibility with COARDS conformant programmes, such as "*ncBrowse*" and "*Ocean Data View*" and incorporate concepts from other conventions, such as the Argo (http://www.argo.ucsd.edu/) and IMOS (Integrated Marine Observing System) conventions (http://imos.org.au/) to GTSPP conventions.

4.2.1. Geographic Coordinate System

All GTSPP data is located by a geographic coordinate system as used in the COARDS and CF conventions. The coordinate system enables every location on the Earth to be specified by a set of numbers. The coordinate variables orient the data in time and space. The coordinates are often chosen such that two of the numbers represent horizontal position, and the other two numbers represents vertical position and time, respectively.

Any one-dimensional netCDF variables whose dimension names are identical to their variable names are regarded as "coordinate variables". For this purpose, they have an “axis” attribute defining that they point in X, Y, Z, and T dimensions.

Coordinate variable names:

<u>X (Longitude) axis</u>

Many longitude representations are possible. However, for compatibility with the COARDS netCDF conventions, use of the East longitude convention is required. The East longitude convention defines the numeric representation of the longitude axis in the netCDF file, with positive values for east longitudes. This means that eastern longitudes are positive numbers, for example, 170E is +170.0. The units of the axis are degrees_east.

<u>Y (Latitude) axis</u>

The recommended latitude convention is for north latitudes to be represented by positive numbers (e.g., 10N is +10.0), and south latitudes by negative numbers (e.g., 10S is -10.0). The units of the axis are degrees_north.

<u>Z (Depth/Pressure) axis</u>

The Z axis may be represented as depth in meters or as pressure in decibars, if, for example pressure is recorded directly by an instrument and the calculation of depth from pressure would cause a loss of information. The preferred unit is the one that is most directly measured by the platform, i.e., depth for XBT and pressure for CTD. The Z axis should be given with the oceanographic convention as a positive number, increasing downwards from the surface of the water towards the bottom of the ocean. The units of the axis should be meters (depth axis) or decibar (pressure axis).

<u>Time axis</u>

The representation of the time axis within the data file can be of several types, including the ISO 8601 date and time standard, the double real numeric array, which will be "days since 1900-01-01 00:00:00 UTC".

4.2.2. Dimensions

GTSPP allows a single parameter for each of the data dimensions, i.e. time, depth (or pressure), latitude and longitude. Requirements are described in Section 4.2.1 on coordinate variables.

Name	**Example**	**Definition**
time	time =1	Dimension of the time coordinate variable.
z	z = 4	Maximum number of vertical observation levels contained in a profile. This dimension depends on the data set.
latitude	latitude = 1	Dimension of the LATITUDE coordinate variable.

Name	Example	Definition
longitude	longitude = 1	Dimension of the LONGITUDE coordinate variable.
num_prof	num_prof = 2	Number of profiles contained in the file. This dimension depends on the data set. A file contains at least one profile.
num_surf	Num_surf=7	Number of surface codes group
num_hist	num_hist = UNLIMITED	Number of history records.
string2	string2 = 2	Size of a character array from 2 to 14.
string4	string4 = 4	
string6	string6 = 6	
string8	string8 = 8	
string10	string10 = 10	
string12	string12 = 12	
string14	string14 = 14	

4.2.3. Variables

GTSPP netCDF variable names use lowercase letters mixed with a "_" (underscore) character. The variables are grouped by a sectional design with:

a) A metadata section that can hold instrument specific metadata (the XBT data section can be different from that used for animal recorders…),

b) A profile data section that parallels the Argo structure with raw, adjusted, and QC fields for each parameter (and perhaps with calibration or error information, comments and notes). All GTSPP data are located by a coordinate system (Appendix B), which is represented by three spatial axes, and one temporal axis. Other information, not included as an axis, must be included elsewhere within the data file, namely, it must contain all metadata associated with the profile and all technical data collected at the same time, if the file is to be self-describing. This may include calibration comments or coefficients, depth qualifiers or serial numbers of all instruments.

c) A complex history section that captures whatever has been done to the profile during processing and QC.

4.2.3.1. Profile Metadata Section

Variable Name (Size)	Data Type	Attribute Name	Attribute Value
format_version (string8)	char		
		long_name	File format version
		comment	Version number of the GTSPP NetCDF format
gtspp_station_id	int		
		long_name	Station ID Number
		cf_role	profile_id
		comment	Identification number of the station in the GTSPP Continuously Managed Database
crc(string8)	char		
		long_name	Cyclic Redundancy Check (CRC)
		_FillValue	X
		comment	A CRC algorithm used to generate an unique data tag of this record
best_quality_flag	int		
		long_name	Best Quality Flag

Variable Name (Size)	Data Type	Attribute Name	Attribute Value
		flag_values	0, 1, 2, 3, 4, 5, 6, 7, 8, 9;
		flag_meanings	no_quality_control_performed good_value probably_good probably_bad bad_value modified_value reserved reserved reserved missing_value
time (time)	double		
		long_name	time
		standard_name	time
		units	days since 1900-01-01 00:00:00
		axis	T
		ancillary_variables	time_quality_flag
		_FillValue	99999.
time_quality_flag	int		
		long_name	Date-Time Quality Flag
		flag_values	0, 1, 2, 3, 4, 5, 6, 7, 8, 9;
		flag_meanings	no_quality_control_performed good_value probably_good probably_bad bad_value modified_value reserved reserved reserved missing_value
		references	http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm
latitude (latitude)	float		
		long_name	latitude
		standard_name	latitude
		units	degrees_north
		axis	Y
		ancillary_variables	q_position
		data_min	-7.94f
		data_max	-7.94f
		valid_min	-90.f
		valid_max	90.f
		_FillValue	99999.f
longitude (longitude)	float		
		long_name	longitude
		standard_name	longitude
		units	degrees_east
		axis	X
		ancillary_variables	q_position
		data_min	55.082f
		data_max	55.082f
		valid_min	-180.f
		valid_max	180.f
		_FillValue	99999.f
position_quality_flag	int		
		long_name	Position Quality Flag
		flag_values	0, 1, 2, 3, 4, 5, 6, 7, 8, 9;
		flag_meanings	no_quality_control_performed good_value probably_good

Variable Name (Size)	Data Type	Attribute Name	Attribute Value
			probably_bad bad_value modified_value reserved reserved reserved missing_value
		references	http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm
qc_version (string4)	char		
		long_name	QC Program Version No.
		comment	Version of the QC program used.
gtspp_temperature_instrument_code(string10)	char		
		long_name	GTSPP Temperature Instrument Code
		instrument_type	ment attached to marine mammals
		recorder_type	
		comment	GTSPP code for temperature instrument type (first three digits, WMO-1770), with fall rate equation coefficients for XBT (last two digits, WMO-4770).
gtspp_platform_code(string10)	char		
		long_name	GTSPP Platform Code
		references	http://www.nodc.noaa.gov/GTSPP/document/codetbls/callist.html
data_type(string2)	char		
		long_name	Data type
		comment	Two-character GTSPP data type
		references	http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#TYPE
one_deg_sq	int		
		long_name	GTSPP geographic one degree square
cruise_id (string10)	char		
		long_name	Cruise_ID
		callsign	Q9900409
		Year	11
		_FillValue	X
source_id (string4)	char		
		long_name	Source ID
		_FillValue	X
		comment	Global Telecommunication System (GTS) node which placed message on the GTS
stream_ident (string4)	char		
		long_name	Stream Identification
		_FillValue	9
		comment	Source and type of data. Bytes 1-2 show the data source center. Bytes 3-4 show data type
uflag	char		
		long_name	Update Flag
		_FillValue	9

Variable Name (Size)	Data Type	Attribute Name	Attribute Value
		comment	Record update action
no_prof	short		
		long_name	Number of Profiles
		comment	Number of Parameter profiles in station
prof_type (no_prof, string4)	char		
		long_name	Profile Type
crs	int		
		long_name	Coordinate Reference System
		grid_mapping_name	latitude_longitude
		epsg_code	EPSG:4326
		longitude_of_prime_meridian	0.0f
		semi_major_axis	6378137.0
		inverse_flattening	298.257223563

Profile Data Section

Variable Name (Size)	Data Type	Attribute Name	Attribute Value
z (z)	float		
		long_name	Depths of the observations
		standard_name	depth
		units	meters
		deepest_depth	40.f
		postive	down
		axis	Z
		ancillary_variables	z_variable_quality_flag
		data_min	0.f
		data_max	40.f
		C_format	%6.2f
		FORTRAN_format	F6.2
		epic_code	3
		_FillValue	99999.f
z_variable_quality_flag (z)	int		
		long_name	Depth/Press Quality Flag
		standard_name	Depth/Press status_flag
		flag_values	0,1,2,3,4,5,9
		flag_meanings	no_quality_control_performed,correct,probably_good,doubtful,erroneous,value_changed,element_missing
		_FillValue	-9
temperature (time, z, latitude, longitude)	float		
		long_name	sea water temperature
		standard_name	sea_water_temperature

Variable Name (Size)	**Data Type**	**Attribute Name**	**Attribute Value**
		units	degrees C
		coordinates	time latitude longitude z
		grid_mapping	crs
		cell_methods	time:point lon:point lat:point z:point
		ancillary_variables	temperature_quality_flag
		data_min	2.3f
		data_max	4.63f
		C_format	%9.4f
		FORTRAN_format	F9.4
		epic_code	28
		_FillValue	99999.f
temperature_quality_flag (z)	int		
		long_name	Global quality flag of sea water temperature profile
		standard_name	sea_water_temperature_qc_flag
		flag_values	0,1,2,3,4,5,9
		flag_meanings	no_quality_control_performed,correct,probably_good,doubtful,erroneous,value_changed,element_missing
		_FillValue	-9
salinity (time, z, latitude, longitude)	float		
		long_name	Practical Salinity
		standard_name	sea_water_salinity
		salinity_scale	psu
		Units	psu
		coordinates	time latitude longitude z
		grid_mapping	crs
		cell_methods	time:point lon:point lat:point z:point
		ancillary_variables	salinity_quality_flag
		data_min	33.91f
		data_max	34.45f
		C_format	%9.4f
		FORTRAN_format	F9.4
		epic_code	41
		_FillValue	99999.f
salinity_quality_flag (z)	int		
		long_name	Global quality flag of sea water salinity profile
		standard_name	sea_water_salinity_qc_flag
		flag_values	0,1,2,3,4,5,9
		flag_meanings	no_quality_control_performed,correct,probably_good,doubtful,erroneous,value_changed,element_missing
		_FillValue	-9

Profile History Section

The history section is perhaps the most complex and hardest to design. It contains an unlimited size dimension for the file and needs to be structured to include many of the things currently described in the "history group" section of GTSPP ASCII format files. It holds a complete record of every test performed and/or failed by the profile, including why the profile has failed a particular test[5].

Variable Name	Data Type	Attribute Name	Attribute Variable
no_hist	short		
		long_name	Number of History groups
hist_identcode (no_hist, , string2)	char		
		long_name	History Identification Code
hist_prccode (no_hist, , string4)	char		
		long_name	History Processing Code
		references	http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#PRC
		comment	Identifies the procedure through which the data passed.
hist_version (no_hist, , string4)	char		
		long_name	History Processing Version
		comment	Identifies the version of the software through which the data passed.
hist_prcdate (no_hist, , string8)	char		
		long_name	History Processing Date
		comment	Records the date as YYYYMMDD that this history record was created.
hist_actcode (no_hist, , string2)	char		
		long_name	History Action Code
		references	http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#PC_HIST
		comment	Identifies the action taken against the data by the software.
hist_actparm (no_hist, , string4)	char		
		long_name	History Action Parm
		references	http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#PC_PARM
		comment	Identifies the measured variable affected by the action.
hist_auxid (no_hist , string8)	char		
		long_name	History Auxilary Identification
		comment	Normally this is the depth at which the value of a variable was acted upon by the software.
hist_ovalue (no_hist, string10)	char		
		long_name	History Original Value
		comment	The original value before being acted upon by software.

4.2.4. Global Attributes

GTSPP suggests that all listed attributes be used and contain meaningful information and should be human-readable. Files must at least contain the attributes listed as "required". Required fields are marked with an asterisk (*). An example entry is provided for each description. In Table 2, the required and recommended global attributes are described.

Table 2. *Lists all the global attributes used to define a GTSPP data file. Required fields are marked with an asterisk (*).*

Attribute Name	Example	Description
conventions*	Conventions = "CF-1.5"	A character array for the name of the conventions used by the file
title*	title = "Global Temperature and Salinity Profile Programme (GTSPP) Data"	A short description of the dataset
summary	summary= " The data source is the GTSPP Continuously Managed Data Base "	The method of production of the original data or resource from which this one is derived.
keywords	:keywords = "temperature, salinity, sea_water_temperature, sea_water_salinity"	The "keywords" attribute lists key words and phrases that are relevant to the dataset
keywords_vocabulary	keywords_vocabulary = "NODC Data Types, CF Standard Names"	The names of guideline used for the words/phrases in "keywords" attribute.
references	references = "http://www.nodc.noaa.gov/GTSPP/"	Published or web-based references that describe the data or methods used to produce it
institution	institution = "U.S. National Oceanographic Data Center"	The data creator's name. The "institution" attribute will be used if the "creator_name" attribute does not exist.
project	project = "Joint IODE/JCOMM Global Temperature-Salinity Profile Programme	The scientific project that produced the data.
id	id = "gtspp_dbid_11579488"	The "id" value should attempt to uniquely identify the dataset. The combination of the "id" and "naming_authority" values should be globally unique for all time.
naming_authority	naming_authority = "gov.noaa.nodc"	backward Uniform Resource Locator (URL) of institution
standard_name_vocabulary	standard_name_vocabulary = "CF-1.5"	The name of the controlled vocabulary from which variable standard names are taken.
metadata_conventions	metadata_conventions = "Unidata Dataset Discovery v1.0"	The names of metadata conventions used.
publisher_name	publisher_name = "US DOC; NESDIS; NATIONAL OCEANOGRAPHIC DATA CENTER - IN295"	The data publisher's name, URL, and email. The publisher may be an individual or an institution.
publisher_url	publisher_url = "http://www.nodc.noaa.gov/GTSPP/"	
publisher_email	publisher_email = "nodc.gtspp@noaa.gov"	
date_created	date_created = "2011-07-21"	The date on which this data was first

Attribute Name	Example	Description
		created.
date_modified	date_modified = "2011-07-21"	The date on which this data was last modified.
date_issued	date_issued = "2011-07-21"	The date on which this data was formally issued.
history	history = "2011-07-21T12:12:53Z csun writeGTSPPnc40.f90 Version 0.2"	Provides an audit trail for modifications to the original data.
acknowledgement	acknowledgment = "These data were acquired from the US NOAA National Oceanographic Data Center (NODC) on [DATE] from http://www.nodc.noaa.gov/GTSPP/.	A place to acknowledge various type of support for the project that produced this data.
license	license = "These data are openly available to the public Please acknowledge the use of these data with the text given in the acknowledgment attribute."	Describe the restrictions to data access and distribution
comment	comment = "GTSPP4.0 adapted the ACDD, COARDS, and CF-1.5 conventions including CF discrete sampling geometry for profiles."	Miscellaneous information about the data or methods used to produce it.
featureType*	featureType = "profile"	Specifies the type of discrete sampling geometry to which the data in the file belongs, and implies that all data variables in the file contain collections of features of that type.
cdm_data_type*	cmd_data_type = "profile"	Gives the THREDDS data type appropriate for this dataset. e.g., "grid", "image", "station", "trajectory", "radial", or “profile”.
geospatial_lat_min*	geospatial_lat_min = 50.58f	Describes a simple latitude, longitude, and vertical bounding box.
geospatial_lat_max*	geospatial_lat_max = 50.58f	
geospatial_lon_min*	geospatial_lon_min = 119.39f	
geospatial_lon_max*	geospatial_lon_max = 119.39f	
geospatial_vertical_min*	geospatial_vertical_min = 5.f	
geospatial_vertical_max*	geospatial_vertical_max = 606.f	
time_coverage_start*	time_coverage_start = "2011-05-01T23:40Z"	Describes the temporal coverage of the data as a time range.
time_coverage_end*	time_coverage_end = "2011-05-01T23:40Z	
time_coverage_duration*	time_coverage_durationn = "point"	
time_coverage_resolution*	time_coverage_resolution = "point"	
geospatial_lat_units	geospatial_lat_units = "degrees_north"	Further refinement of the geospatial bounding box can be provided by using these units and resolution attributes.
geospatial_lat_resolution	geospatial_lat_resolution = "point"	
geospatial_lon_units	geospatial_lon_units = "degrees_east"	

Attribute Name	Example	Description
geospatial_lon_resolution	geospatial_lon_resolution = "point"	
geospatial_vertical_units	geospatial_vertical_units = "meters"	
geospatial_vertical_resolution	geospatial_vertical_resolution = "point"	
geospatial_vertical_positive	geospatial_vertical_positive = "down"	
GTSPP_ConventionVersion	GTSPP_ConventionVersion = "GTSPP4.0"	GTSPP specific netCDF conventions control version number
GTSPP_program	GTSPP_program = "writeGTSPPnc40.f90"	The filename of a computer file used to create the netCDF format files.
GTSPP_programVersion	GTSPP_programVersion = "0.2"	The version number of the computer program used to create the netCDF format files.
GTSPP_handbook_version	GTSPP_handbook_version = "GTSPP Data User\'s Manual 1.0"	GTSPP data user's manual version number.
lexicon	lexicon= "NODC_GTSPP"	GTSPP data set identification

We will use a small netCDF example to illustrate the concepts of netCDF dimensions, variables, and attributes.

4.3. Common Data Language (CDL)

The notation used to describe this simple netCDF object is called CDL (network Common Data form Language). Common Data Language (CDL) is a human readable text notation that is used to describe the netCDF objects. The NetCDF utility *"ncdump"* convert netCDF object binary to CDL text. The netCDF utility *"ncgen"* creates a netCDF binary file from a well-formed CDL text file. It provides an easily comprehended text version of the structure and contents of a binary netCDF file.

A CDL description of a netCDF dataset takes the form:

```
netCDF name {
     dimensions: .
     variables: .
     data: .
}
```

where the name is used only as a default in constructing file names by the *"ncgen"* utility. The CDL description consists of three optional parts, each introduced by the keywords 'dimensions', 'variables' and 'data'. NetCDF dimension declarations appear after the dimensions keyword, netCDF variables and attributes are defined after the variables keyword, and variable data assignments appear after the data keyword. CDL statements are terminated by a semicolon. Spaces, tabs and new lines can be used freely for readability. Comments in CDL follow the characters '//' on any line (Rew et al 2008).

A simple CDL example which describes GTSPP netCDF data collected from an autonomous pinniped bathythermograph (APBT) is shown in Appendix B.

4.4. File Naming Conventions

The GTSPP NetCDF filenames can be up to 255 characters in length and are composed of four fields separated by '_' (underscore) characters. The filenames always begin with 'gtspp' to indicate the data files are produced by the GTSPP and end with an extension of '.nc' to indicate they are stored in the NetCDF format. All filenames are lowercase and can be a combination of letters and numbers. The NetCDF file name format is:

```
gtspp_<station_identification>_<data_type>_<q_pos><q_date_time><b_record>.nc
```

All six (6) fields are mandatory and must conform to the following contents:

a) gtspp: Name of the programme[2]

b) <station_identification>: GTSPP continuously managed database identification number

c) <data_type>: list of data type codes (two alphabetical letters) from the GTSPP data type reference table.

d) <q_pos>: Position Quality Flag,

e) <q_date_time>: Date-Time Quality Flag, and

f) <b_record>: Best Quality Flag.

As an example, a data file with filename of "gtspp_11741662_te_111.nc", indicates itself:

a) *"gtspp"* : a GTSPP data,

b) *"11741662"*: derived from the GTSPP CMD database identification number,

c) *"te"*: the data type is TESAC message,

d) *"1"*: the position quality code of the record is "1", ,

e) *"1"*: the date-time quality code of the record is '1', and

f) *"1"*: the best quality flag of the record is '1'.

5. GTSPP CODES AND PLATFORM CODES TABLES

GTSPP has developed a system of letters and numbers that gives information about the data and how they were collected. The system is commonly known as the GTSPP codes or code tables which can be found at:

http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html.

GTSPP data files contain ship call signs, platform codes and names, and NODC ship codes stored in the GTSPP database. The complete set of ship call signs, platform names and NODC platform codes is included in http://www.nodc.noaa.gov/GTSPP/document/codetbls/calllist.html

6. DATA ACCESS

6.1. Online Data Access

The GTSPP data are available on-line through the GTSPP HTTP and FTP servers. This section describes the structure of the GTSPP real-time and best copy data. The real-time data are

[2] Any data produced by GTSPP should be instantly identifiable as 'gtspp' data

updated three times a week and the best copy data are updated on or about the 7th of each month.

Users are allowed to view data file summaries, view station location plots, and download monthly best copy data sets sorted by ocean and month of the year. All on-line data are distributed in the GTSPP ASCII and NetCDF formats. Users, who only need a subset of the data of their interest, use the GTSPP Web Interface (GWI) or submit a request to the GTSPP data manager via email at nodc.gtspp@noaa.gov.

The data are organized as a small set of directory hierarchies. The top level of the directory tree contains a README file (this file) and two plain text files, "*gtspp_add.tx*t" and "*gtspp_rmd.txt"*, showing the GTSPP database identification numbers and names of the individual files are being added or removed, respectively.

The sub-trees are:

atlantic/
best/
best_inv/
best_nc/
best_sum/
indian/
realtime/
pacific/

The following sections descript the detail information about these sub-directories:

atlantic/
This directory contains individual profile (stations) netCDF files for observations in the Atlantic Ocean from 1990 to present.

best/
The "best" directory contains the GTSPP best copy data sets in the MEDS ASCII format. The MEDS ASCII datasets are split into three oceans, and are assembled as months of years and compressed, using the unix utility "gzip". The file naming convention is OOYYYYMM.gz, where OO is a two-character ocean code (at=atlantic, in=indian, and pa=pacific), YYYY is a four-digit Year, MM is the two-digit Month of the year, and ".gz", is a special extension for files compressed using the "gzip" unix utility. The definitions of ocean boundaries used to divide GTSPP data are shown in Appendix C.

best_inv/
The "best_inv" directory contains inventory files for each monthly archive. Each file lists the call sign of platforms, the path and the file names of netCDF files, the stations with observations in that month giving the sampling date (year, month, and day), location (latitude and longitude, negative numbers are for southern latitudes and western longitudes), and data min/maxes. Fields with missing min/maxes indicate the data quality is probably bad or bad. Appendix D describes the detail information of the ocean-month data index files.

best_nc/
The "best_nc" directory contains the GTSPP best copy data with only TEMP and PSAL data records stored in the netCDF format. The GTSPP netCDF datasets are split into three oceans, and are assembled as months of years and compressed, using the unix utility "zip". The file naming convention is "gtspp_OOYYYYMM.zip", where OO is a two-character ocean code (at=atlantic, in=indian, and pa=pacific), YYYY is a four-digit Year, MM is the two-digit Month of the year, and ".zip", is a special extension for files compressed using the "zip" unix utility.

best_sum/
This directory contains the GTSPP statistics of each ocean-month. Each file reports date range, Lat/Lon boundaries, and counts of Stations by data types, and Profiles by profile data types.

indian/
This directory contains individual profile (stations) netCDF files for observations in the Indian Ocean from 1990 to present.

realtime/
This directory contains the GTSPP monthly real-time data sorted by year-month. All real-time files are distributed in MEDS ASCII (text) format. The file naming convention is rtmMMYY.meds.gz, where YY is a two-digit Year and MM is the two-digit Month of the year. Files with .txt extension are the statistics of the corresponding monthly real-time data sets

pacific/
This directory contains individual profile (stations) netCDF files for observations in the Pacific Ocean from 1990 to present

6.2. Offline Data Delivery

The GTSPP continues to publish data on optical disc media. As the disc uses the ISO 9660 standard with the RockRidge extension, the platform-independent files can, in principle, be read on all operating systems. The production of the GTSPP on optical disc media is available at user's request only. The GTSPP data users should contact the GTSPP data manager via email at nodc.gtspp@noaa.gov .

7. APPLICATIONS

GTSPP netCDF data formats can be integrated seamlessly with freely available desktop visualization and analysis tools such as:

a) ncBrowse (http://www.epic.noaa.gov/java/ncBrowse/) and
b) Ocean Data View (http://www.awi-bremerhaven.de/GEO/ODV/).

The following two sections describe how to use ncBrowe and Ocean Data View for manipulating the data.

7.1. ncBrowse

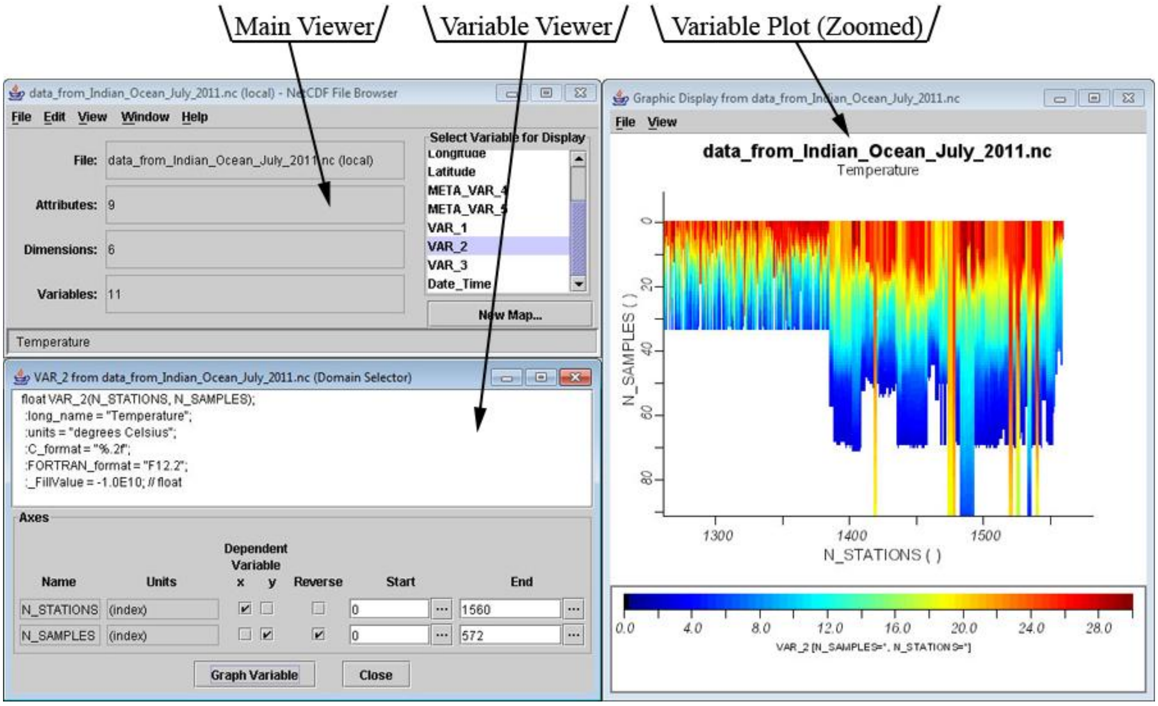
ncBrowse is a Java application that provides flexible, interactive graphical displays of data and attributes from a wide range of netCDF data file conventions.

7.1.1. Opening NetCDF (*.nc) Files

ncBrowse can easily read either individual station files unzipped from a GTSPP *.tgz file or a data array of several stations exported from *Ocean Data View* (see section 7.2). When a netCFD file is opened, the programme will display some basic information about the file, including the number of dimensions, attributes and variables used in the file.

7.1.2. Alternate Data Views

Selecting *View > As Table* or *View > As Tree* can also display the file structure as a table or tree. Both views provide additional information on the file structure, including the names and definitions of the file's dimensions, the values contained in the file's main metadata attributes, and the descriptions of defined variables and what dimensions they use.

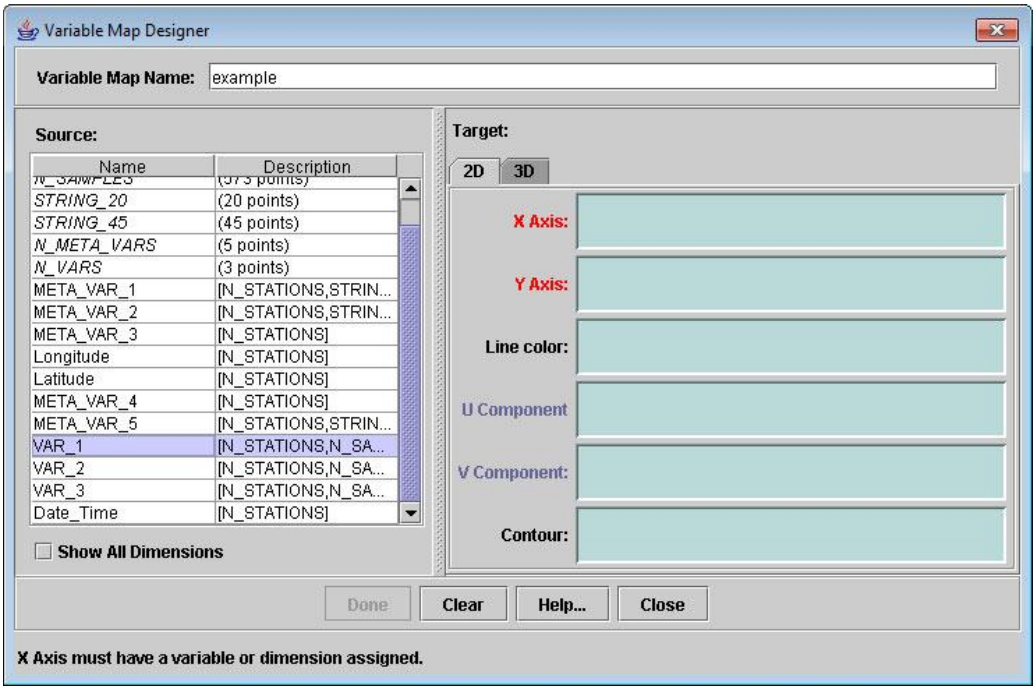


7.1.3. Simple Variable Plotting

To view variable data as a plot, double click on a variable from the list on the right hand side of the main view *window*. The variable viewer window will open, and plot axes and ranges can be adjusted as needed. Click on *Graph Variable* to plot the variable. Drawing a box anywhere on the plot window can zoom into sections of the resulting plot.

7.1.4. Advanced Plotting

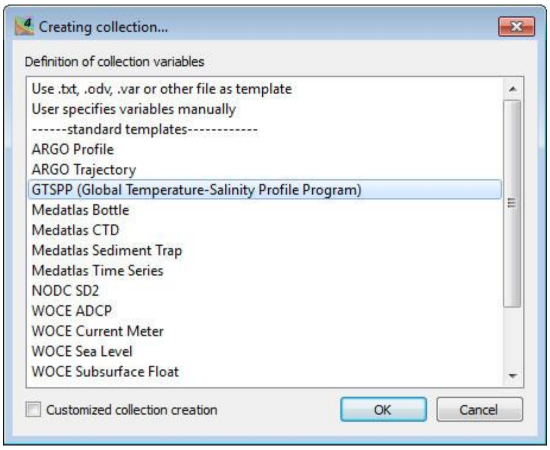
A custom plot comparing two or three different variables can also be made using *ncBrowse*. Click on *New Map* in the main view window to open the Variable Map Designer. Variables are assigned to axes by dragging and dropping into the appropriate axis field. After the new variable map has been named, it can be viewed in a similar manner as a standard variable by double clicking. (The new variable map will be listed at the bottom in blue.) As with simple plots, axes and ranges may be adjusted here before clicking on *Plot*. The resulting plot can be zoomed or printed as with a simple plot. Please note that custom variable maps are not saved to the netCDF file itself any may have to be redefined if the file is reopened.



7.2. Ocean Data View

Ocean Data View (*ODV*) is a software package for the interactive exploration, analysis and visualization of oceanographic and other geo-referenced profile or sequence data.

7.2.1. Importing Data



Upon opening *ODV*, create a new collection by selecting *File* > *New* or *Ctrl-N.* After naming the new collection, a list of variable templates will be offered, including an option for GTSPP data.

After the collection has been created, GTSPP data can be imported by selecting *Import* > *U.S. NODC Formats* > *GTSPP. ODV* is able to import from zipped GTSPP files (*.tgz), NetCDF files (*.nc) or File List files (*.lst).

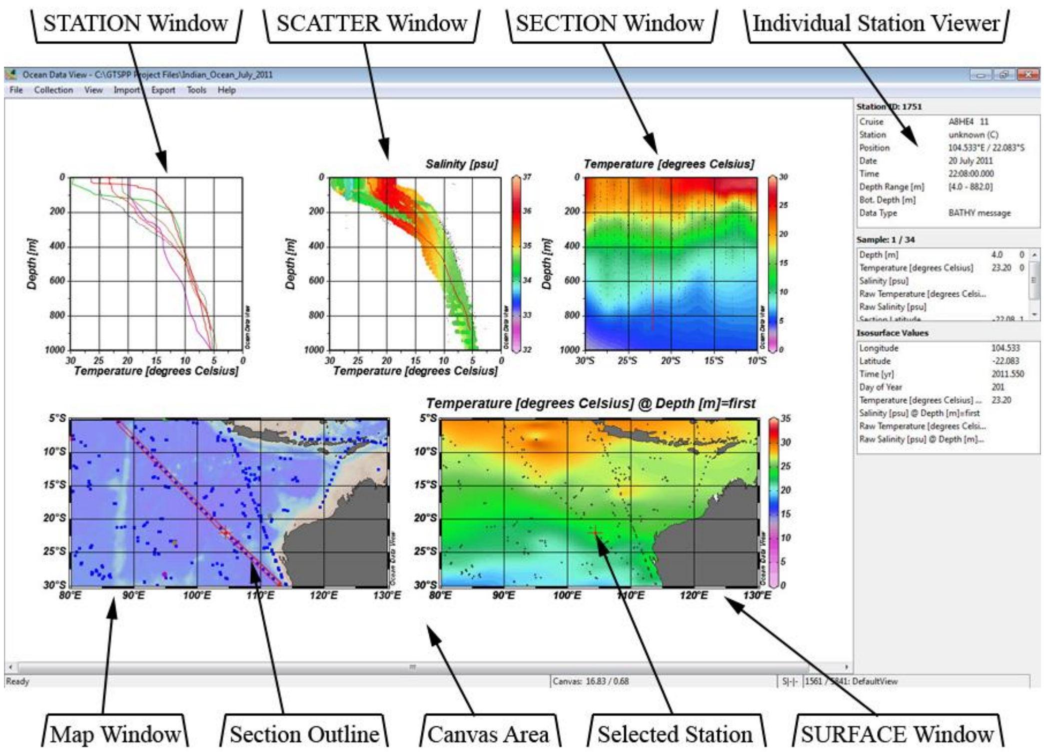
During importing stations will be plotted as red dots on a world projection map, which will zoom in to the relevant domain after finishing. An option to sort and condense the imported data for ease of use will be offered after all station data has been imported. Importing and sorting may take quite a few minutes depending on the number of stations being imported and processing speed.

7.2.2. Canvas Layout

Below is a sample layout of the *ODV* canvas view, including a map of the region of interest and four additional windows that demonstrate some of the basic methods to display data.

The two main ways to generate new windows on the canvas is by selecting a template or switching to the Window Layout screen. To use a template, right click on any open part of the canvas and use the *Layout Templates* submenu to select a template. The window types are outlined in section 7.2.4.

The Window Layout screen can be accessed by right clicking on any open part of the canvas and selecting *Window Layout* or by pressing *Ctrl-W.* Left click on any window in this view to move or resize, or on the canvas to add a new window. Window properties and variable assignments may also be adjusted in this view. Press *Enter* to accept the changes or *Esc* to cancel and return to the main canvas view. The canvas layout is automatically saved to the collection file every time the canvas is adjusted. Right clicking on the canvas and selecting *Save View As* can also save layout views separately.



7.2.3. The Map Window

The Map Window is the first window that will be displayed after importing data into *ODV*. Left clicking on the map will offer several options in manipulating the map and indicating what data will be used for plotting graphs.

Some important commands:

Zoom – Allows zooming into a section of the map using a sizing box.

Auto Zoom In/Out **–** Does a simple zoom-in or out of the area.

Valid Domain – Automatically zooms the map to encompass stations that match set criteria (location, cruise, date, etc. See below for setting station criteria.)

Full Domain **–** Zooms map out to encompass all stations included in the collection.

Global Map **–** Zooms map out to a global view.

Current Station by Name/ID – Pinpoint a station on the map based on the station's name or ID. A red cross will indicate the selected station on the map and the station's data will be displayed in the left-hand viewer.

Station/Sample Selection Criteria – Restricts stations visible on the map or samples that will be considered based on location, name, cruise, id, date and time, and other variables. Samples can be filtered based on the quality flags of various variables.

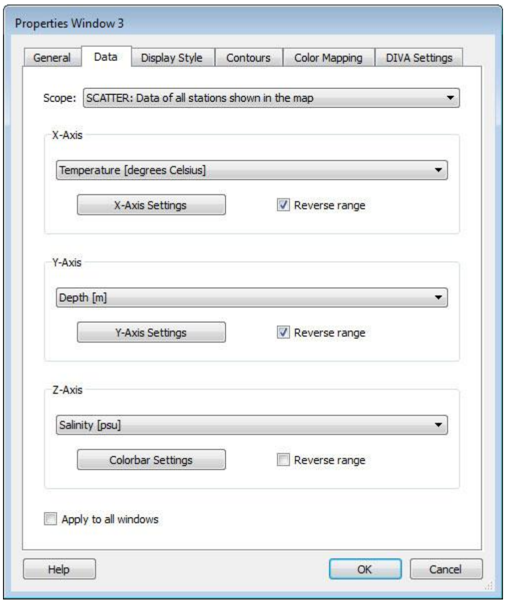
Manage Pick List – Submenu that manages a running list of stations of interest. The pick list can be added to by pressing Enter when a station is selected on the map. Data from stations on the pick list can be plotted using a *STATION* plot (see below).

Manage Section – Submenu that can be used to load or define a section line. A section is defined by drawing a multi-segmented line on the map. Data from stations within the section can be visualized using a *SECTION* plot (see below). Only stations that intersect with the line segments will be considered when using a Section Data plot.

Properties – Map properties that can be adjusted include color palette, map projection, detail layers, display coordinates, annotations and labeling. Changes to the map's size can be made using the *Window Layout* view.

7.2.4. *Data Windows*

There are four basic ways to display station data using the data windows:



STATION – Displays data from stations listed on the user-defined pick list (see above) as overlapping line plots color-coded for each station. This display uses only two variables (for example, depth and temperature).

SCATTER – Displays data from all stations that appear on the map and match the user-defined Station or Sample Criteria (see above). The data is displayed as a scatter plot and can use three variables. The third variable is visualized using a prismatic color mapping scale that can be adjusted in the properties window.

SECTION – Displays data that only intersects with the user-defined section line. The plot can use three variables, such as latitude, longitude, depth, and temperature. The data is initially displayed as columns of colored dots, but it can also be visualized as a prismatic gridded field using simple, VG or DIVA gridding.

SURFACE – Displays surface data, usually as an isosurface map, using a prismatic scale. Like a *SECTION* window, the data can be visualized as colored dots or as a colorful gridded field.

All data windows can be zoomed into using the same commands as map window. There are a few other useful commands specific to these windows that need to be addressed:

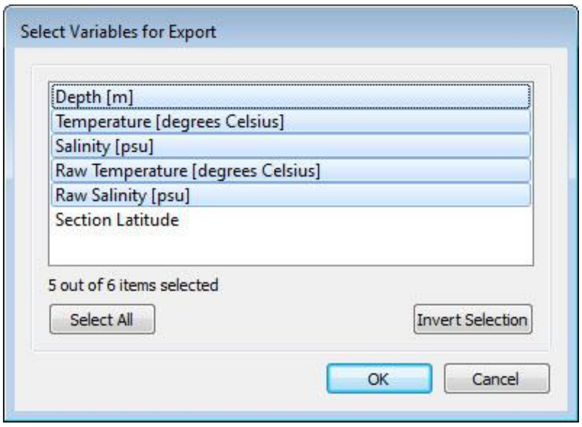
Full Range – Display data at using the minimum and maximum ranges suggested by the data for all axes.

Set Range – Custom set the minimum and maximum values to be displayed for each axis.

X/Y/Z-Variable – Quickly set which variable is used for an axis.

7.2.5. *Exporting Data*

Data in *ODV* can be exported in a number of ways:



As an Image or Printout – To save a snapshot image or printout of the canvas, simply right click con the canvas and select Save Canvas As or Print Canvas. Individual windows can be saved and printed in a similar manner by right clicking on the window of interest.

As a Spreadsheet File – Data that have been narrowed down by selection criteria can be exported to a *.txt file for use in any text editor or spreadsheet program. This can be achieved by selecting *Export > ODV Spreadsheet*. The range of data and what variables to be exported can be further refined when creating the export file.

As a netCDF File – As with a spreadsheet export, the selected data can be exported to a *.nc file for use in a netCDF program such as ncBrowse (see section 7.1). To export, select *Export > netCDF File*. Again, the data and number of variables exported can be refined when saving.

8. ACKNOWLEDGEMENTS

Many agencies play important roles in the Global Temperature and Salinity Profile Programme (GTSPP) data system. Countries include Argentina, Australia, Canada, China, France, Germany, India, Italy, Japan, UK, and USA. The most important contributors are the collectors of the original data. Without their efforts, this compilation of data and information would not have been possible.

With contributions from Drs Ann Thresher, Norman Hall, and Ms Elanore Hall, Dr Charles Sun, GTSPP Chair, led the preparation and completion of the manual. Mr Derrick Snowden reviewed the first draft of the manual. The NetCDF working group of the U.S. National Oceanographic Data Center (NODC) provided suggestions for the GTSPP NetCDF conventions.

This work was partially supported by the U.S. NODC management and the International Oceanographic Data and Information Exchange (IODE) Programme of the Intergovernmental Oceanographic Commission.

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Appendix A: GTSPP ASCII FORMAT DESCRIPTION

The ASCII (character) format used by GTSPP for the delivery of the data is moderately complex since it provides information in addition to the actual observations. The data format was originated by ISDM. It makes use of a number of international codes to describe the data and how they were collected. International vessel call sign tables and ship platform names are also provided.

The data are organized in the following manner. A 'Station' record always appears first followed by one or more 'Profile' records. All records are of variable length, with the exact number of fields to be found being provided in the record.

The complete description of the fields of the format is provided below.

The 'Station' Record

The 'Station' record is built of a number of components. The first component always has a fixed number of fields and is always present. This component provides information about the location and time of the station, information about how the data were received and the number of repeats of other components found in the 'Station' record.

The second component provides information about the number of profiles measured at the station, whether or not a profile is a duplicate of another, higher resolution copy, and some information about the accuracy and precision of the variables measured. The deepest depth of each profile is recorded here. Because of limitations of records lengths on some computers, profiles are broken into a number of segments. Each segment has up to 1,500 depth-variable pairs. There are as many repeats of this component as required to describe all profiles present. The actual number of profile records associated with a station is the sum of the number of segments of each profile.

The third component carries information about other variables measured at the station, such as winds, air temperature, and so on. The measurements are expressed as numeric values. A code table is used to indicate the variable measured. There are as many repeats of this component as required to describe all numeric variables present.

The fourth component carries information about other variables measured at the station but which are recorded as alphanumeric. Such measurements as Beaufort winds, QC tests executed, etc. are to be found here. There are as many repeats of this component as required to describe all alphanumeric variables present.

The last component records the processing history of the station. It provides information about who carried out which actions against what variable and when. If values have been changed, the original value is stored in this component. There are as many repeats of this component as required to describe all the processing that has taken place on the station.

Suppose that a temperature and a salinity profile were collected at a station. Suppose also that there were observations every meter to 3,500 m depth. Suppose also that wind speed and direction were measured, that the Beaufort wind speed was recorded and that the station had 5 different actions taken against it. The layout of the station record is then as follows.

Component	Contents
1	Station location, time and other information.
2	Two repeats of profile information, one for temperature and one for salinity.
3	Two repeats, one for each of wind speed and direction.
4	One repeat for the Beaufort code.
5	Five repeats of the history information, one to describe each action taken against the record.

The 'Profile' Record

There may be one or more 'Profile' records associated with each station record. The associated 'Profile' records always follow immediately after the station record to which they are linked.

There are two components to a 'Profile' record. The first always has a fixed number of fields and is always present. This component provides a repeat of the station location and time. It identifies the profile type and segment of that profile. It indicates if depths or pressures are recorded and how many depth-variable pairs are to be found.

The second component records the depth and measured variable as well as quality control flags that have been applied at each depth. There are as many repeats of this component as required to describe all depths (pressures) measured in the profile.

For the example data collection described above, the layout of the profile records is as follows.

Component	Contents
1	Station location, time, profile and segment identifiers.
2	Up to 1500 repeats of depth-variable information and associated quality control flags.

File Organization

For the above example, the organization of a data file would be as follows.

Format Description

Field Name	Field Size	Starting Position	Justify (L / R)	Field Description
--------------	-----------	--------------	-------	----------------------------------
MKey	char*08	01	L	Sort Key
One_Deg_sq	char*08	09	R	MEDS geographic 1 degree square
Cruise_ID	char*10	17	L	Radio callisgn + year for real time data, or NODC reference number for delayed mode data.
Obs_Year	char*04	27	L	Century and year of Observation
Obs_Month	char*02	31	L	Month of Observation
Obs_Day	char*02	33	L	Day of Observation 01-31
Obs_Time	char*04	35	L	Time of Observation
Data_Type	char*02	39	L	Instrument type or type of IGOSS radio message
Iumsgno	char*12	41	R	A unique identifier used by MEDS in their processing
Stream_Sour	char*01	53	L	A field used by MEDS to track if the data are new or have

Field Name	Field Size	Starting Position	Justify (L / R)	Field Description
ce				been retrieved from its archives.
Uflag	char*01	54	L	Record update action
Stn_Number	char*08	55	R	MEDS Station Number for real-time data, or cruise consec number for delayed mode data.
Latitude	char*08	63	R	Decimal degrees (+ = north, - = south)
Logitude	char*09	71	R	Decimal degrees (+ = west, - = east)
Q_Pos	char*01	80	L	Station Position Quality
Q_Date_Time	char*01	81	L	Date-Time Quality
Q_Record	char*01	82	L	Worst Quality flag in the station
Up_Date	char*08	83	L	Date of last action on record
Bul_Time	char*12	91	L	Time bulletin was placed on GTS
Bul_Header	char*06	103	L	GTS bulletin header
Source_ID	char*04	109	L	GTS node which placed message on the GTS.
Stream_Ident	char*04	113	L	Source and type of data
QC_Version	char*04	117	L	Version of the QC program used.
Data_Avail	char*01	121	L	Data Availability
No_Prof	char*02	122	R	Number of Parameter profiles in station
Nparms	char*02	124	R	Number of Surface Parameter groups
Nsurfc	char*02	126	R	Number of Surface Codes groups
Num_Hists	char*03	128	R	Number of History groups
Profile Information; repeats No_prof (1-30) times				
No_Seg	char*02	01	R	Number of Profile Records in the profile
Prof_Type	char*04	03	L	Type of data in profile
Dup_flag	char*01	07	L	'Y' indicates this station duplicates another higher quality.
Digit_Code	char*01	08	L	Data Digitization method
Standard	char*01	09	L	Standards to which the observations were made
Deep_Depth	char*05	10	R	Depth (m) of the deepest observation in the profile.
Surface Parameter Group; repeats Nparms (0-30) times				
Pcode	char*04	01	L	Parameter - GF3 or User code.
Parm	char*10	05	R	Measured surface parameter value.
Q_Parm	char*01	15	L	Parameter Quality
Surface Codes Group; repeats Nsurfc (0-30) times				
SRFC_Code	char*04	01	L	Parameter - GF3 or User code.
SRFC_Parm	char*10	05	L	Surface code
SRC_Q_Parm	char*01	15	L	Parameter Quality
History Group; repeats Num_Hists (0-100) times				
Ident_Code	char*02	01	L	Organization which created the record
PRC_Code	char*04	03	L	Computer program which modified the station and created a history group

Field Name	Field Size	Starting Position	Justify (L / R)	Field Description
Version	char*04	07	L	Version of the above program
PRC_Date	cahr*08	11	R	Date of action (YYYYMM)
Act_Code	cahr*02	19	L	Action performed on parameter
Act_Parm	char*04	21	L	Parameter code of changed parameter
Aux_ID	char*08	25	R	Locator (e.g. depth) of changed parameter
Previous_Val	char*10	33	R	Value of parameter before change
Profile Record				
MKey	char*08	01	L	Sort Key
One_Deg_sq	char*08	09	R	MEDS geographic 1 degree square
Cruise_ID	char*10	17	L	Radio callisgn + year for real time data or NODC reference number for delayed mode data.
Obs_Year	char*04	27	L	Century and year of Observation
Obs_Month	char*02	31	L	Month of Observation
Obs_Day	char*02	33	L	Day of Observation 01-31
Obs_Time	char*04	35	L	Time of Observation
Data_Type	char*02	39	L	Instrument type or type of IGOSS radio message
Iumsgno	char*12	41	R	MEDS field - not used
Profile_Type	char*04	53	L	Type of data in the profile
Profile_Seg	char*02	57	L	Profile segment number of this record
No_Depths	cahr*04	59	R	Number of Depth/Pressure values in this record
D_P_Code	char*01	63	L	Depth/Pressure code
Paramter Group; occurs No_Depth (1-1500) times				
Depth_Press	char*06	01	R	Depth or Pressure value
Depres_Q	char*01	07	L	Depth/Pressure quality
Prof_Parm	char*09	08	R	Measured parameter value
Prof_Q_Parm	char*01	17	L	Data Quality

APPENDIX B: EXAMPLE OF COMMON DATA LANGUAGE REPRESENTATION

Common Data Language (CDL) is text notation for NetCDF files. This is an example GTSPP formatted NetCDF file for an autonomous pinniped bathythermograph (APBT) data in the CDL representation.

```
netcdf gtspp_11579488_te_111 {
dimensions:
   string2 = 2 ;
   string4 = 4 ;
   string6 = 6 ;
   string8 = 8 ;
   string10 = 10 ;
   string12 = 12 ;
   string14 = 14 ;
   time = 1 ;
   z = 27 ;
   latitude = 1 ;
   longitude = 1 ;
   num_prof = 2 ;
   num_surf = 7 ;
   num_hist = UNLIMITED ; // (9 currently)
variables:
   char format_version(string8) ;
      format_version:long_name = "File Format Version" ;
      format_version:comment = "Version number of the GTSPP NetCDF format"
;
   int gtspp_station_id ;
      gtspp_station_id:long_name = "Station ID Number" ;
      gtspp_station_id:cf_role = "profile_id" ;
      gtspp_station_id:comment = "Identification number of the station in
the GTSPP Continuously Managed Database" ;
   char crc(string8) ;
      crc:long_name = "Cyclic Redundancy Check (CRC)" ;
      crc:_FillValue = "X" ;
      crc:comment = "A CRC algorithm used to generate an unique data tag of
this record" ;
   int best_quality_flag ;
      best_quality_flag:long_name = "Best Quality Flag" ;
      best_quality_flag:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
      best_quality_flag:flag_meanings = "no_quality_control_performed
good_value probably_good probably_bad bad_value modified_value reserved
reserved reserved missing_value" ;
      best_quality_flag:references =
"http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm" ;
   double time(time) ;
      time:long_name = "time" ;
      time:standard_name = "time" ;
      time:units = "days since 1900-01-01 00:00:00" ;
      time:axis = "T" ;
      time:ancillary_variables = "time_quality_flag" ;
      time:_FillValue = 99999. ;
   int time_quality_flag ;
      time_quality_flag:long_name = "Date-Time Quality Flag" ;
      time_quality_flag:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
      time_quality_flag:flag_meanings = "no_quality_control_performed
good_value probably_good probably_bad bad_value modified_value reserved
reserved reserved missing_value" ;
```

```
      time_quality_flag:references =
"http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm" ;
   float latitude(latitude) ;
      latitude:long_name = "latitude" ;
      latitude:standard_name = "latitude" ;
      latitude:units = "degrees_north" ;
      latitude:axis = "Y" ;
      latitude:ancillary_variables = "position_quality_flag" ;
   float longitude(longitude) ;
      longitude:long_name = "longitude" ;
      longitude:standard_name = "longitude" ;
      longitude:units = "degrees_east" ;
      longitude:axis = "X" ;
      longitude:ancillary_variables = "position_quality_flag" ;
   int position_quality_flag ;
      position_quality_flag:long_name = "Position Quality Flag" ;
      position_quality_flag:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
      position_quality_flag:flag_meanings = "no_quality_control_performed
good_value probably_good probably_bad bad_value modified_value reserved
reserved reserved missing_value" ;
      position_quality_flag:references =
"http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm" ;
   char qc_version(string4) ;
      qc_version:long_name = "QC Program Version No." ;
      qc_version:comment = "Version of the QC program used." ;
   char gtspp_temperature_instrument_code(string10) ;
      gtspp_temperature_instrument_code:long_name = "GTSPP Temperature
Instrument Code" ;
      gtspp_temperature_instrument_code:instrument_type = "ment attached to
marine mammals" ;
      gtspp_temperature_instrument_code:recorder_type = "" ;
      gtspp_temperature_instrument_code:comment = "GTSPP code for
temperature instrument type (first three digits, WMO-1770), with fall rate
equation coefficients for XBT (last two digits, WMO-4770)." ;
      gtspp_temperature_instrument_code:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/wmocode.html" ;
   char gtspp_platform_code(string10) ;
      gtspp_platform_code:long_name = "GTSPP Platform Code" ;
      gtspp_platform_code:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/callist.html" ;
   char data_type(string2) ;
      data_type:long_name = "Data Type" ;
      data_type:comment = "ble CTD" ;
      data_type:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#TYPE" ;
   int one_deg_sq ;
      one_deg_sq:long_name = "GTSPP geographic one degree square" ;
   char cruise_id(string10) ;
      cruise_id:long_name = "Cruise_ID" ;
      cruise_id:callsign = "Q9900409" ;
      cruise_id:year = "11" ;
      cruise_id:_FillValue = "X" ;
      cruise_id:comment = "Radio callsign + year for real time data" ;
   char source_id(string4) ;
      source_id:long_name = "Source ID" ;
      source_id:_FillValue = "X" ;
      source_id:comment = "Global Telecommunication System (GTS) node which
placed message on the GTS" ;
```

```
   char stream_ident(string4) ;
      stream_ident:long_name = "Stream Identification" ;
      stream_ident:_FillValue = "X" ;
      stream_ident:comment = "Source and type of data. Bytes 1-2 show the
data source center. Bytes 3-4 show data type" ;
   char uflag(time) ;
      uflag:long_name = "Update Flag" ;
      uflag:_FillValue = "X" ;
      uflag:comment = "Record update action" ;
   short no_prof ;
      no_prof:long_name = "Number of Profiles" ;
      no_prof:comment = "Number of Parameter profiles in station" ;
   char prof_type(num_prof, string4) ;
      prof_type:long_name = "Profile Type" ;
   float z(z) ;
      z:long_name = "Depths of the observations" ;
      z:standard_name = "depth" ;
      z:units = "meters" ;
      z:deepest_depth = 606.f ;
      z:postive = "down" ;
      z:axis = "Z" ;
      z:ancillary_variables = "z_variable_quality_flag" ;
      z:data_min = 5.f ;
      z:data_max = 606.f ;
      z:C_format = "%6.2f" ;
      z:FORTRAN_format = "F6.2" ;
      z:epic_code = 3 ;
   int z_variable_quality_flag(z) ;
      z_variable_quality_flag:long_name = "Depth/Press Quality Flag" ;
      z_variable_quality_flag:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
      z_variable_quality_flag:flag_meanings = "no_quality_control_performed
good_value probably_good probably_bad bad_value modified_value reserved
reserved reserved missing_value" ;
      z_variable_quality_flag:references =
"http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm" ;
   float temperature(time, z, latitude, longitude) ;
      temperature:long_name = "sea water temperature" ;
      temperature:standard_name = "sea_water_temperature" ;
      temperature:units = "degrees_C" ;
      temperature:coordinates = "time latitude longitude z" ;
      temperature:grid_mapping = "crs" ;
      temperature:cell_methods = "time:point lon:point lat:point z:point" ;
      temperature:ancillary_variables = "temperature_quality_flag" ;
      temperature:data_min = 2.3f ;
      temperature:data_max = 4.63f ;
      temperature:C_format = "%9.4f" ;
      temperature:FORTRAN_format = "F9.4" ;
      temperature:epic_code = 28 ;
      temperature:_FillValue = 99999.f ;
   int temperature_quality_flag(z) ;
      temperature_quality_flag:long_name = "Global quality flag of sea
water temperature profile" ;
      temperature_quality_flag:standard_name = "sea_water_temperature
status_flag" ;
      temperature_quality_flag:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9;
      temperature_quality_flag:flag_meanings =
"no_quality_control_performed good_value probably_good probably_bad
bad_value modified_value reserved reserved reserved missing_value" ;
```

```
      temperature_quality_flag:references =
"http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm" ;
   float salinity(time, z, latitude, longitude) ;
      salinity:long_name = "Practical Salinity" ;
      salinity:standard_name = "sea_water_salinity" ;
      salinity:salinity_scale = "psu" ;
      salinity:units = "psu" ;
      salinity:coordinates = "time latitude longitude z" ;
      salinity:grid_mapping = "crs" ;
      salinity:cell_methods = "time:point lon:point lat:point z:point" ;
      salinity:ancillary_variables = "salinity_quality_flag" ;
      salinity:data_min = 33.91f ;
      salinity:data_max = 34.45f ;
      salinity:C_format = "%9.4f" ;
      salinity:FORTRAN_format = "F9.4" ;
      salinity:epic_code = 41 ;
      salinity:_FillValue = 99999.f ;
   int salinity_quality_flag(z) ;
      salinity_quality_flag:long_name = "Global quality flag of sea water
salinity profile" ;
      salinity_quality_flag:standard_name = "sea_water_salinity_qc_flag" ;
      salinity_quality_flag:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
      salinity_quality_flag:flag_meanings = "no_quality_control_performed
good_value probably_good probably_bad bad_value modified_value reserved
reserved reserved missing_value" ;
      salinity_quality_flag:references =
"http://www.nodc.noaa.gov/GTSPP/document/qcmans/qcflags.htm" ;
   short no_surf ;
      no_surf:long_name = "Number of Surface Codes Groups" ;
   char surfacecodes_pcode(num_surf, string4) ;
      surfacecodes_pcode:long_name = "Surface Parameter Code" ;
      surfacecodes_pcode:comment = "Consult the GTSPP and WMO Code Tables
to interpret what variable this is" ;
      surfacecodes_pcode:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html" ;
   char surfacecodes_cparm(num_surf, string10) ;
      surfacecodes_cparm:long_name = "Surface Parameter Value" ;
      surfacecodes_cparm:comment = "Consult the GTSPP and WMO Code Tables
to interpret what variable this is" ;
   short no_hist ;
      no_hist:long_name = "Number of History groups" ;
   char hist_identcode(num_hist, string2) ;
      hist_identcode:long_name = "History Identification Code" ;
   char hist_prccode(num_hist, string4) ;
      hist_prccode:long_name = "History Processing Code" ;
      hist_prccode:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#PRC" ;
      hist_prccode:comment = "Identifies the procedure through which the
data passed." ;
   char hist_version(num_hist, string4) ;
      hist_version:long_name = "History Processing Version" ;
      hist_version:comment = "Identifies the version of the software
through which the data passed." ;
   char hist_prcdate(num_hist, string8) ;
      hist_prcdate:long_name = "History Processing Date" ;
      hist_prcdate:comment = "Records the date as YYYYMMDD that this
history record was created." ;
   char hist_actcode(num_hist, string2) ;
```

```
      hist_actcode:long_name = "History Action Code" ;
      hist_actcode:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#PC_HIST"
;
      hist_actcode:comment = "Identifies the action taken against the data
by the software." ;
   char hist_actparm(num_hist, string4) ;
      hist_actparm:long_name = "History Action Parm" ;
      hist_actparm:references =
"http://www.nodc.noaa.gov/GTSPP/document/codetbls/gtsppcode.html#PC_PARM"
;
      hist_actparm:comment = "Identifies the measured variable affected by
the action." ;
   char hist_auxid(num_hist, string8) ;
      hist_auxid:long_name = "History Auxilary Identification" ;
      hist_auxid:comment = "Normally this is the depth at which the value
of a variable was acted upon by the software." ;
   char hist_ovalue(num_hist, string10) ;
      hist_ovalue:long_name = "History Original Value" ;
      hist_ovalue:comment = "The original value before being acted upon by
software." ;
   int crs ;
      crs:long_name = "Coordinate Reference System" ;
      crs:grid_mapping_name = "latitude_longitude" ;
      crs:epsg_code = "EPSG:4326" ;
      crs:longitude_of_prime_meridian = "0.0f" ;
      crs:semi_major_axis = "6378137.0" ;
      crs:inverse_flattening = "298.257223563" ;

// global attributes:
      :Conventions = "CF-1.5" ;
      :title = "Global Temperature and Salinity Profile Programme (GTSPP)
Data" ;
      :summary = "The data source is the GTSPP Continuously Managed Data
Base" ;
      :keywords = "temperature, salinity, sea_water_temperature,
sea_water_salinity" ;
      :keywords_vocabulary = "NODC Data Types, CF Standard Names" ;
      :references = "http://www.nodc.noaa.gov/GTSPP/" ;
      :institution = "U.S. National Oceanographic Data Center" ;
      :projct = "Joint IODE/JCOMM Global Temperature-Salinity Profile
Programme" ;
      :id = "gtspp_dbid_11579488" ;
      :naming_authority = "gov.noaa.nodc" ;
      :standard_name_vocabulary = "CF-1.5" ;
      :Metadata_Convention = "Unidata Dataset Discovery v1.0" ;
      :publisher_name = "US DOC; NESDIS; NATIONAL OCEANOGRAPHIC DATA CENTER
- IN295" ;
      :publisher_url = "http://www.nodc.noaa.gov/GTSPP/" ;
      :publisher_email = "nodc.gtspp@noaa.gov" ;
      :date_created = "2011-11-25" ;
      :date_modified = "2011-11-25" ;
      :date_issued = "2011-11-25" ;
      :history = "2011-11-25T21:35:22Z csun writeGTSPPnc40.f90 Version 0.5"
;
      :acknowledgment = "These data were acquired from the US NOAA National
Oceanographic Data Center (NODC) on [DATE] from
http://www.nodc.noaa.gov/GTSPP/." ;
```

```
      :license = "These data are openly available to the public Please
acknowledge the use of these data with the text given in the
acknowledgment attribute." ;
      :comment = "GTSPP4.0 adapted the ACDD, COARDS, and CF-1.5 conventions
including CF discrete sampling geometry for profiles." ;
      :featureType = "profile" ;
      :cdm_data_type = "profile" ;
      :geospatial_lat_min = -50.58f ;
      :geospatial_lat_max = -50.58f ;
      :geospatial_lon_min = 119.39f ;
      :geospatial_lon_max = 119.39f ;
      :geospatial_vertical_min = 5.f ;
      :geospatial_vertical_max = 606.f ;
      :geospatial_lat_units = "degrees_north" ;
      :geospatial_lat_resolution = "point" ;
      :geospatial_lon_units = "degrees_east" ;
      :geospatial_lon_resolution = "point" ;
      :geospatial_vertical_units = "meters" ;
      :geospatial_vertical_resolution = "point" ;
      :geospatial_vertical_positive = "down" ;
      :time_coverage_start = "2011-05-01T23:40Z" ;
      :time_coverage_end = "2011-05-01T23:40Z" ;
      :time_coverage_duration = "point" ;
      :time_coverage_resolution = "point" ;
      :gtspp_ConventionVersion = "GTSPP4.0" ;
      :gtspp_program = "writeGTSPPnc40.f90" ;
      :gtspp_programVersion = "0.5" ;
      :gtspp_handbook_version = "GTSPP Data User\'s Manual 1.0" ;
      :LEXICON = "NODC_GTSPP" ;
data:

 format_version = "GTSPP4.0" ;

 gtspp_station_id = 11579488 ;

 crc = "XXXXXXXX" ;

 best_quality_flag = 1 ;

 time = 40662.986111111 ;

 time_quality_flag = 1 ;

 latitude = -50.58 ;

 longitude = 119.39 ;

 position_quality_flag = 1 ;

 qc_version = "1.3 " ;

 gtspp_temperature_instrument_code = "99599     " ;

 gtspp_platform_code = "33P2      " ;

 data_type = "TE" ;

 one_deg_sq = 61040 ;
```

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 cruise_id = "Q990040911" ;

 source_id = "EGRR" ;

 stream_ident = "METE" ;

 uflag = "U" ;

 no_prof = 2 ;

 prof_type =
  "TEMP",
  "PSAL" ;

 z =   5.00,  15.00,  25.00,  35.00,  45.00,  55.00,  64.00,  74.00,
84.00,
     94.00, 104.00, 114.00, 124.00, 134.00, 144.00, 154.00, 164.00,
173.00,
    198.00, 248.00, 297.00, 347.00, 396.00, 446.00, 495.00, 545.00, 606.00
;

 z_variable_quality_flag = 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 ;

 temperature =
     4.6300,
     4.6300,
     4.6200,
     4.6000,
     4.5800,
     4.5700,
     4.5700,
     4.5700,
     4.5600,
     4.5500,
     4.5700,
     4.5200,
     4.0500,
     3.7000,
     3.4400,
     3.0400,
     2.8700,
     2.7700,
     3.1000,
     2.5800,
     2.3000,
     2.4200,
     2.8300,
     2.7000,
     2.7600,
     2.6200,
     2.5700 ;

 temperature_quality_flag = 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 ;

 salinity =
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```
    33.9100,
    33.9100,
    33.9100,
    33.9100,
    33.9100,
    33.9100,
    33.9100,
    33.9200,
    33.9200,
    33.9200,
    33.9300,
    33.9800,
    34.0500,
    34.0600,
    34.0800,
    34.0500,
    34.0300,
    34.0400,
    34.1000,
    34.0800,
    34.1000,
    34.1700,
    34.2700,
    34.3100,
    34.3800,
    34.4000,
    34.4500 ;

 salinity_quality_flag = 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 ;

 no_surf = 7 ;

 surfacecodes_pcode =
  "PFR$",
  "QCP$",
  "QCF$",
  "STAT",
  "DBID",
  "PLAT",
  "ACCS" ;

 surfacecodes_cparm =
  "99599     ",
  "  41E1FFDF",
  "  00000001",
  "1         ",
  "11579488  ",
  "33P2      ",
  "0072625   " ;

 no_hist = 9 ;

 hist_identcode =
  "ME",
  "ME",
  "ME",
  "ME",
```

```
 "ME",
 "NO",
 "NO",
 "NO",
 "NO" ;

hist_prccode =
 "IG02",
 "QCA1",
 "QCA1",
 "IGO3",
 "IG05",
 "tstm",
 "tstc",
 "ld01",
 "plat" ;

hist_version =
 "2.0 ",
 "1.0 ",
 "1.0 ",
 "1.1 ",
 "2.1 ",
 "2.18",
 "1.7 ",
 "1.27",
 "1.11" ;

hist_prcdate =
 "20110504",
 "20110504",
 "20110504",
 "20110504",
 "20110504",
 "20110505",
 "20110505",
 "20110505",
 "20110606" ;

hist_actcode =
 "CR",
 "ED",
 "QC",
 "DC",
 "QC",
 "CR",
 "CR",
 "CR",
 "UP" ;

hist_actparm =
 "RCRD",
 "CCLL",
 "RCRD",
 "RCRD",
 "RCRD",
 "RCRD",
 "RCRD",
```

```
  "RCRD",
  "PLAT" ;

 hist_auxid =
  "9999.999",
  "9999.999",
  "9999.999",
  "9999.999",
  "0.000   ",
  "9999.999",
  "9999.999",
  "9999.999",
  "9999.999" ;

 hist_ovalue =
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  "9999.999  ",
  "9999.999  ",
  "0.00000   ",
  "0.00000   ",
  "9999.999  ",
  "9999.999  ",
  "9999.999  ",
  "9999      " ;

 crs = _ ;
}
```

APPENDIX C: GTSPP OCEAN BOUNDARY DEFINITIONS

The definitions of ocean boundaries used to divide GTSPP data are shown in Figure 5. Below the figure are tables giving the coordinates of the boundaries.

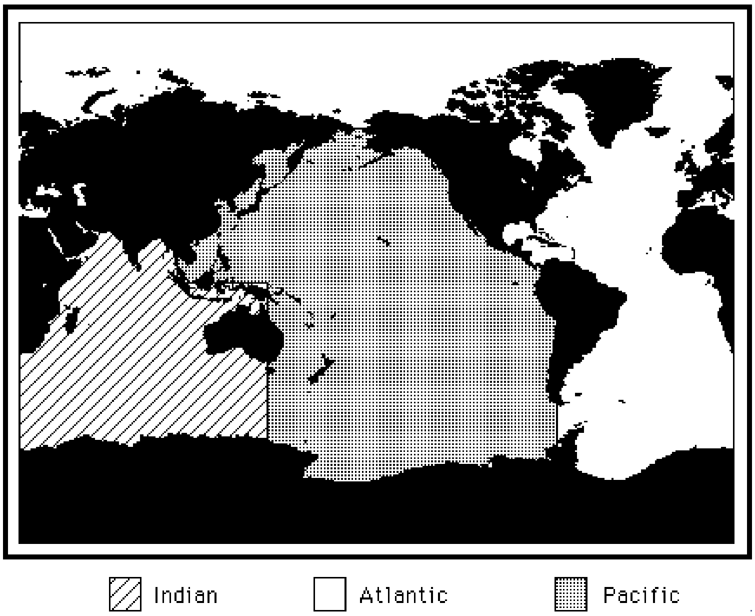

Figure 5. GTSPP Ocean Boundaries

Atlantic Ocean		
Longitude band	**Southern Latitude**	**Northern Latitude**
100 E - 020 E	31 deg. N	90 deg. N
020 E - 070 W	80 deg. S	90 deg. N
070 W - 084 W	09 deg. N	90 deg. N
084 W - 090 W	14 deg. N	90 deg. N
090 W - 100 W	18 deg. N	90 deg. N
100 W - 100 E	66 deg. N	90 deg. N
Indian Ocean		
Longitude band	**Southern Latitude**	**Northern Latitude**
020 E - 100 E	80 deg. S	31 deg. N
100 E - 145 E	80 deg. S	0 deg.
Pacific Ocean		
Longitude band	**Southern Latitude**	**Northern Latitude**
070 W - 080 W	80 deg. S	9 deg. N
080 W - 084 W	80 deg. S	9 deg. N
084 W - 090 W	80 deg. S	14 deg. N
090 W - 100 W	80 deg. S	18 deg. N
100 W - 145 E	80 deg. S	66 deg. N
145 E - 100 E	0 deg.	66 deg. N

APPENDIX D: GTSPP DATA FILES INDEXING

To allow for data discovery without downloading the data files themselves, index (inventory) files are created for each ocean basins and each month number of the year, beginning January1990. Inventories are the comma separated value ASCII text files. Every netCDF file in has a single entry (i.e. line) in the inventory files. These inventory tables will facilitate searching the GTSPP data base according to user parameters. The tables will also serve as the foundation for forming OPeNDAP URLs. The first line of every inventory must be a column header line, indicating what is in each column. Every variable is separated by a COMMA and each line is ended with a new line (NL). The index files list all available data files and the location and time ranges of the data and contain a header line, which starts with #character, then, followed information lines. The information lines are comma-separated values, and contain the following information:

a) **callSign**: Platform's call sign assigned by WMO,
b) **data_URL**: The complete URL of the data,
c) **file**: The path and the file name of the data, using a tree-structure like folder hierarchy in the order of "ocean/year/month/file_name".
d) **ocean**: The name of the ocean,
e) **date**: observation date ,
f) **time**: observation time,
g) **time_qc**: quality flag of observation date and time,
h) **latitude**: latitude of the observation in decimal degrees north,
i) **longitude**: longitude of the observation in decimal degrees east ,
j) **position_qc**: quality flag of position,
k) **data_center**: a two-letter code of data center,
l) **d_p_code**: one letter code, D for water depths in meter and P for water pressures in decibars,
m) **num_of_levels**: number of vertical observation levels,
n) **min_D_P**: minimum depth or pressure,
o) **max_D_P**: maximum depth or pressure,
p) **num_of_param**: the number of parameters,
q) **param1**: a 4-letter parameter code , DEPH or PRES,
r) **param2**: a 4-letter parameter code, TEMP or PSAL,
s) **param3**: ,a 4-letter parameter code, TEMP or PSAL if any,
t) **param4**: if any, and
u) **param5**:, if any.

Table 3. *GTSPP data file index sample file*

GTSPP data files index:
#callSign,data_URL,file,ocean,date,time,time_qc,latitude,longitude,position_qc,data_center,d_p_code,num_of_levels,min_D_P,max_D_P,num_of_param,param1,param2,param3,param4,param5 14041,http://data.nodc.noaa.gov/gtspp/indian/2011/05/gtspp_11579784_te_111.nc,indian/2011/05/gtspp_11579784_te_111.nc,2011-05-01,12:00,1,-7.9400,55.0820,1,ME,D,4,0.0,40.0,3,DEPH,TEMP,PSAL

IOC Manuals and Guides

No.	Title
1 rev. 2	Guide to IGOSS Data Archives and Exchange (BATHY and TESAC). 1993. 27 pp. (English, French, Spanish, Russian)
2	International Catalogue of Ocean Data Station. 1976. *(Out of stock)*
3 rev. 3	Guide to Operational Procedures for the Collection and Exchange of JCOMM Oceanographic Data. Third Revised Edition, 1999. 38 pp. (English, French, Spanish, Russian)
4	Guide to Oceanographic and Marine Meteorological Instruments and Observing Practices. 1975. 54 pp. (English)
5 rev. 2	Guide for Establishing a National Oceanographic Data Centre. Second Revised Edition, 2008. 27 pp. (English) *(Electronic only)*
6 rev.	Wave Reporting Procedures for Tide Observers in the Tsunami Warning System. 1968. 30 pp. (English)
7	Guide to Operational Procedures for the IGOSS Pilot Project on Marine Pollution (Petroleum) Monitoring. 1976. 50 pp. (French, Spanish)
8	*(Superseded by IOC Manuals and Guides No. 16)*
9 rev.	Manual on International Oceanographic Data Exchange. (Fifth Edition). 1991. 82 pp. (French, Spanish, Russian)
9 Annex I	*(Superseded by IOC Manuals and Guides No. 17)*
9 Annex II	Guide for Responsible National Oceanographic Data Centres. 1982. 29 pp. (English, French, Spanish, Russian)
10	*(Superseded by IOC Manuals and Guides No. 16)*
11	The Determination of Petroleum Hydrocarbons in Sediments. 1982. 38 pp. (French, Spanish, Russian)
12	Chemical Methods for Use in Marine Environment Monitoring. 1983. 53 pp. (English)
13	Manual for Monitoring Oil and Dissolved/Dispersed Petroleum Hydrocarbons in Marine Waters and on Beaches. 1984. 35 pp. (English, French, Spanish, Russian)
14	Manual on Sea-Level Measurements and Interpretation. (English, French, Spanish, Russian)
	Vol. I: Basic Procedure. 1985. 83 pp. (English)
	Vol. II: Emerging Technologies. 1994. 72 pp. (English)
	Vol. III: Reappraisals and Recommendations as of the year 2000. 2002. 55 pp. (English)
	Vol. IV: An Update to 2006. 2006. 78 pp. (English)
15	Operational Procedures for Sampling the Sea-Surface Microlayer. 1985. 15 pp. (English)
16	Marine Environmental Data Information Referral Catalogue. Third Edition. 1993. 157 pp. (Composite English/French/Spanish/Russian)
17	GF3: A General Formatting System for Geo-referenced Data
	Vol. 1: Introductory Guide to the GF3 Formatting System. 1993. 35 pp. (English, French, Spanish, Russian)
	Vol. 2: Technical Description of the GF3 Format and Code Tables. 1987. 111 pp. (English, French, Spanish, Russian)
	Vol. 3: Standard Subsets of GF3. 1996. 67 pp. (English)
	Vol. 4: User Guide to the GF3-Proc Software. 1989. 23 pp. (English, French, Spanish, Russian)
	Vol. 5: Reference Manual for the GF3-Proc Software. 1992. 67 pp. (English, French, Spanish, Russian)

No.	Title
	Vol. 6: Quick Reference Sheets for GF3 and GF3-Proc. 1989. 22 pp. (English, French, Spanish, Russian)
18	User Guide for the Exchange of Measured Wave Data. 1987. 81 pp. (English, French, Spanish, Russian)
19	Guide to IGOSS Specialized Oceanographic Centres (SOCs). 1988. 17 pp. (English, French, Spanish, Russian)
20	Guide to Drifting Data Buoys. 1988. 71 pp. (English, French, Spanish, Russian)
21	*(Superseded by IOC Manuals and Guides No. 25)*
22 rev.	GTSPP Real-time Quality Control Manual, First revised edition. 2010. 145 pp. (English)
23	Marine Information Centre Development: An Introductory Manual. 1991. 32 pp. (English, French, Spanish, Russian)
24	Guide to Satellite Remote Sensing of the Marine Environment. 1992. 178 pp. (English)
25	Standard and Reference Materials for Marine Science. Revised Edition. 1993. 577 pp. (English)
26	Manual of Quality Control Procedures for Validation of Oceanographic Data. 1993. 436 pp. (English)
27	Chlorinated Biphenyls in Open Ocean Waters: Sampling, Extraction, Clean-up and Instrumental Determination. 1993. 36 pp. (English)
28	Nutrient Analysis in Tropical Marine Waters. 1993. 24 pp. (English)
29	Protocols for the Joint Global Ocean Flux Study (JGOFS) Core Measurements. 1994. 178 pp . (English)
30	MIM Publication Series:
	Vol. 1: Report on Diagnostic Procedures and a Definition of Minimum Requirements for Providing Information Services on a National and/or Regional Level. 1994. 6 pp. (English)
	Vol. 2: Information Networking: The Development of National or Regional Scientific Information Exchange. 1994. 22 pp. (English)
	Vol. 3: Standard Directory Record Structure for Organizations, Individuals and their Research Interests. 1994. 33 pp. (English)
31	HAB Publication Series:
	Vol. 1: Amnesic Shellfish Poisoning. 1995. 18 pp. (English)
32	Oceanographic Survey Techniques and Living Resources Assessment Methods. 1996. 34 pp. (English)
33	Manual on Harmful Marine Microalgae. 1995. (English) [superseded by a sale publication in 2003, 92-3-103871-0. UNESCO Publishing]
34	Environmental Design and Analysis in Marine Environmental Sampling. 1996. 86 pp. (English)
35	IUGG/IOC Time Project. Numerical Method of Tsunami Simulation with the Leap-Frog Scheme. 1997. 122 pp. (English)
36	Methodological Guide to Integrated Coastal Zone Management. 1997. 47 pp. (French, English)
37	Post-Tsunami Survey Field Guide. First Edition. 1998. 61 pp. (English, French, Spanish, Russian)
38	Guidelines for Vulnerability Mapping of Coastal Zones in the Indian Ocean. 2000. 40 pp. (French, English)
39	Manual on Aquatic Cyanobacteria – A photo guide and a synopsis of their toxicology. 2006. 106 pp. (English)
40	Guidelines for the Study of Shoreline Change in the Western Indian Ocean Region. 2000. 73 pp. (English)

No.	Title
41	Potentially Harmful Marine Microalgae of the Western Indian Ocean Microalgues potentiellement nuisibles de l'océan Indien occidental. 2001. 104 pp. (English/French)
42	Des outils et des hommes pour une gestion intégrée des zones côtières - Guide méthodologique, vol.II/ Steps and Tools Towards Integrated Coastal Area Management – Methodological Guide, Vol. II. 2001. 64 pp. (French, English; Spanish)
43	Black Sea Data Management Guide *(Cancelled)*
44	Submarine Groundwater Discharge in Coastal Areas – Management implications, measurements and effects. 2004. 35 pp. (English)
45	A Reference Guide on the Use of Indicators for Integrated Coastal Management. 2003. 127 pp. (English). *ICAM Dossier No. 1*
46	A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management. 2006. iv + 215 pp. (English). *ICAM Dossier No. 2*
47	TsunamiTeacher – An information and resource toolkit building capacity to respond to tsunamis and mitigate their effects. 2006. DVD (English, Bahasa Indonesia, Bangladesh Bangla, French, Spanish, and Thai)
48	Visions for a Sea Change. Report of the first international workshop on marine spatial planning. 2007. 83 pp. (English). *ICAM Dossier No. 4*
49	Tsunami preparedness. Information guide for disaster planners. 2008. (English, French, Spanish)
50	Hazard Awareness and Risk Mitigation in Integrated Coastal Area Management. 2009. 141 pp. (English). *ICAM Dossier No. 5*
51	IOC Strategic Plan for Oceanographic Data and Information Management (2008–2011). 2008. 46 pp. (English)
52	Tsunami risk assessment and mitigation for the Indian Ocean; knowing your tsunami risk – and what to do about it. 2009. 82 pp. (English)
53	Marine Spatial Planning. A Step-by-step Approach. 2009. 96 pp. (English). *ICAM Dossier No. 6*
54	Ocean Data Standards Series: Vol. 1: Recommendation to Adopt ISO 3166-1 and 3166-3 Country Codes as the Standard for Identifying Countries in Oceanographic Data Exchange. 2010. 13 pp. (English) Vol. 2: Recommendation to adopt ISO 8601:2004 as the standard for the representation of date and time in oceanographic data exchange. 2011. 17 pp. (English)
55	Microscopic and Molecular Methods for Quantitative Phytoplankton Analysis. 2010.114 pp. (English)
56	The International Thermodynamic Equation of Seawater—2010: Calculation and Use of Thermodynamic Properties. 2010. 190 pp. (English)
57	Reducing and managing the risk of tsunamis. Guidance for National Civil Protection Agencies and Disaster Management Offices as Part of the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas Region – NEAMTWS *(in preparation)*
58	How to Plan, Conduct, and Evaluate Tsunami Exercises *(in preparation)*
59	Guía para el diseño y puesta en marcha de un plan de seguimiento de microalgas productoras de toxinas *(in preparation)*
60	Global Temperature and Salinity Profile Programme (GTSPP) — Data user's manual, 1st Edition 2012. 2011. 48 pp. (English)