DITI/IDT
SISMER

C. MAILLARD
M. FICHAUT
MEDAR/MEDATLAS GROUP

December 2001 - R.INT.TMSI/IDM/SISMER/SIS00-084

Medar-Medatlas Protocol

Part I : EXCHANGE FORMAT AND QUALITY CHECKS FOR OBSERVED PROFILES

V 3

The MEDAR/MEDATLAS Consortium

The MEDAR/MEDATLAS consortium is composed of representatives of the National Oceanographic Data Centres and Designated National Agencies of the Mediterranean bordering countries, of specialists of objective analysis and of experts from the international organisations involved in oceanographic data management:

- IFREMER/SISMER, INST. FRANÇAIS DE RECH. POUR L'EXPLOITATION DE LA MER, France (Catherine Maillard, Michèle Fichaut)
- IEO, INSTITITUTO ESPANOL DE OCEANOGRAFIA, Spain (Maria-Jesus Garcia)
- OGS/DOGA, OSSERVATORIO GEOFISICO SPERIMENTALE, Italy (Beniamno Manca)
- NCMR/HNODC NATIONAL CENTRE FOR MARINE RESEARCH, Greece (Efstatios Balopoulos)
- GHER, UNIVERSITÉ DE LIÈGE, Belgium (Jean-Marie Beckers, Michel Rixen)
- IOLR, ISRAEL OCEANOGRAPHIC & LIMNOLOGICAL RESEARCH, Israel (Steve Brenner, Isaac Gertman)
- IOC, INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION, France (Iouri Oliounine)
- CNR/IMGA CONSIGLIO NAZIONALE DELLE RICERCHE, Italy (Nadia Pinardi)
- ENEA/CRAM, ENTE PER LE NUOVE TECNOLOGIE L'ENEGIA E L'AMBIENTE, Italy (Giuseppe Manzella)
- ICES, INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA, Denmark (Harry Dooley)
- TN-DNHO, DEPT. OF NAVIGATION, HYDROGRAPHY AND OCEANOGRAPHY, Turkey (Huseyin Yüce, Mustafa Ozyalvac)
- INRH/DOTM, INSTITUT NATIONAL DE RECHERCHE HALIEUTIQUE, Morocco (Abdellatif Orbi)
- ISMAL, INST. SCIENCES DE LA MER & DE L'AMÉNAGEMENT DU LITTORAL, Algeria (Mustapha Boulahdid, Redouane Boukort)
- UM-PO, UNIVERSITY OF MALTA -DEPARTMENT OF BIOLOGY, Physical Oceanography Unit, Malta (Aldo Drago)
- CyNODC, MININTERY OF AGRICULTURE, NATURAL RESSOURCES & ENVIRONMENT - FISHERIES DEPT., Cyprus (George ZODIATIS)
- NCSR-NCMS, NATIONAL COUNCIL FOR SCIENTIFIC RESEARCH, Batroun Oceanographic Centre, Lebanon
- NIOF/ENODC, NATIONAL INSTITUTE OF OCEANOGRAPHY AND FISHERIES, Egyptian NODC, Egypt (Ibrahim Maiza, Sherif El-Agami)
- RIHMI-WDC, ALL RUSSIAN SC. RES.INST. OF HYDROMETEOR. INF. - WORLD DC, Russian Federation (Nicholay Mikhailov, Evgeny Vyazilov)
- MHI/MIST, MARINE HYDROPHYSICAL INSTITUTE, Ukraine (Alexander Suvorov)
- NIMH, NAT. INST. METEOROLOGY & HYDROLOGY - ACADEMY OF SCIENCES, Bulgaria (Georgi Kortchev)

Participation of advising data centres (WDCA, MEDGOOS) and other countries data centres will be acknowledged.

CONTENT

1. INTRODUCTION TO THE MEDAR/MEDATLAS PROTOCOL

1.1. Context and Overall objectives

It has been stressed in several documents that the world-wide concern for protecting the marine environment, following up the environmental changes in the marine waters, and managing the living and non-living resources, request the compilation of long time series of observations of:

- Dissolved Oxygen: deficiencies in the upper layers, which come from discharge of sewage, industrial, agricultural and aqua cultural effluents, can result in diminution of higher life forms, liberation of toxic forms of metals and pathology in living organisms.
- Nutrients: changes in nutrients fluxes, whatever natural or introduced to the sea partly as a result of human activity, can alter primary production and the bio-diversity, and can directly affect aquaculture, fishing activity.
- Temperature and Salinity: which are the primary indicators of climate changes and allow the computation of permanent (geostrophic) currents, and other derived parameters such as density and sound velocity, currently used in the off shore industry (oil prospecting, communication cable lay out, remote data transmission).

As expressed in several international workshops under the auspices of the intergovernmental Oceanographic Commission of UNESCO, these requirements are specially important in the Mediterranean context where, due to the narrow shelf and slope areas, the coastal zone environment has strong interrelation with deep sea regions. The MEDAR/MEDATLAS project aims to insure perennial archiving and availability of such parameters of the ecosystem monitoring.

The present protocol described the common rules necessary to insure coherence and compatibility of the archived data sets. It gives also a methodology to detect and eliminate the duplicates, which are a major problem in historical data sets. To facilitate it, the data are organised by country and by cruise and related to the national cruise catalogues.
It is based on 1) the international standards from UNESCO/IOC and ICES in the framework of the International Oceanographic Data and Information Exchange (IODE) and Global Ocean Data Archaeology and Rescue (GODAR) programmes, and 2) the former protocols and experience gained in other MAST data management initiatives: the pilot MAST/MEDATLAS (MAS2-CT93-0074) project, MODB (MAS2-CT93-0075-BE) and MTPII/MATER in the Mediterranean Sea.

1.2. Archived Parameters

The list of core environmental parameters to rescue and safeguard in priority has been defined in a workshop held in Istanbul in May 1997 (1):

- Temperature
- Salinity
- Oxygen
- Nitrate + Nitrite
- Nitrite
- Ammonia
- Total Nitrogen
- Phosphate
- Total Phosphorus
- Silicate
- H2S
- pH
- Alkalinity
- Chlorophyll-a

When selecting these parameters, it was taken into account that a significant preliminary knowledge on the expected values existed to allow quality checks to be carried out.

1.3. Quality Assurance

The Quality Checks (QC) are necessary to insure comparability and coherence between the data sets, and a direct further scientific or operational use. The quality of the data depends on all the stages of processing:

1. The data shall be collected, corrected from instrumental errors, processed and scientifically validated by the source laboratories according to the internationally agreed standard procedures ;
2. Copies of the validated data are transmitted are to the National Oceanographic Data Centre (NODC) or the Designated National Agency (DNA) to be reformatted at a unique format, checked for quality, safeguarded, merged in larger data sets of the same types and disseminated for further use.

The list of the QC follows the international recommendations of UNESCO/IOC, ICES and MAST (2). As a result, the values are not modified, but a quality flag is added to each numerical value. In case of on recent data, the originator can be contacted to take necessary actions like correction or elimination of outliers before archiving. The data managers who have no responsibility on the scientific validation cannot take these actions, but the use of the quality flag allows any automatic further processing.

1.4. MEDATLAS Format

To qualify and exchange, it is necessary to use a common unique format. The MEDATLAS format is used for vertical profiles. This format was originally designed by the MEDATLAS and MODB consortia in conformity with the international the ICES/IOC GETADE recommendations (3). It has been revised with minor modifications to safeguard multidisciplinary parameters and additional information on the experimental conditions when available.

The following requirements have been taken into account:

1) To facilitate the reading of the data, (but neither to optimise the data archiving on the magnetic medium, nor to speed up the data processing).

2) To be independent of the computer.

The consequence of these two points is that an auto-descriptive ASCII format will be preferred.

3) To keep track of the history of the data including the data collection and the processing. Then each cruise must be documented.

4) To allow the processing of profile independently. Therefore the date, time and geographical co-ordinate must be reported on each profile header (and not in separate files).

5) To be flexible and accept (almost) any number of different parameters.

6) The real numbers (real numbers must remain in the same way as they have been transmitted, not reformatted into integer numbers).

These requirements have been taken into account in the MEDATLAS exchange format which has been designed by the MEDATLAS and MODB consortia, in the frame of the European MAST II program.

1.5. Copyright and Data Dissemination

Each participating institute keeps the copyright on its data holdings and the data exchange is submitted to a contractual agreement. At the end of the project, the observed data, the analysed data, the documentation and maps will be released in the public domain in form of a value added data product on CD-ROM, co-authored by all the participants. Each participant will receive a number of copies of the final product to answer the data requests of his/her national community. Each laboratory that contributed to the data collection will get a free author copy of the database.

2. MEDATLAS FORMAT - Datasets Organisation & Identifiers

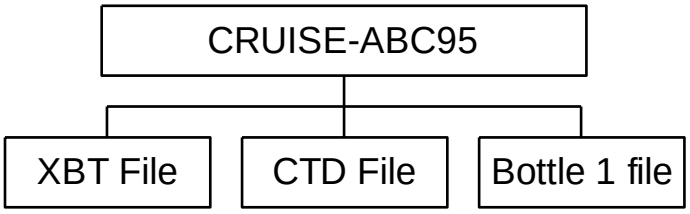
2.1. Data sets organisation

2.1.1. Files Organisation

Even if they are reformatted at a unique common format, the data remain organised as close as possible from the original data sets. They are organised in files. Each file corresponds to:

- Data from only one cruise and
- Data of the same type: (e.g. bottles, CTD, XBt, thermistor chains etc.).

Several files can be related to one cruise: either because they correspond to different data type, or if for any reason, the stations have been split into several files:



2.1.2. Meta-data and Data Organisation within a file

Each file includes successively :

1. a short cruise descriptor based on the international ROSCOP information;
2. a profile (station) header including the cruise reference, the originator station reference within the cruise, date, time, location, the list of observed parameters with units and all the necessary environmental information on the observations ;
3. the data points of the profile.

The sequence 'profile header + data records ' is repeated for each profile.

The parameters archived are observed parameters. The calculated parameters like density or potential temperature are not archived.
Each observed parameter is in a separate column. Each record line consists in data collected at the same level. The record (line) length is not limited for observed data but reasonable (<120) number of characters in the lines is recommended. Accordingly there is no limitation to the number of parameters (columns) but the number of parameters within the same cruise must be constant. If a parameter is missing in one station, the corresponding column must be fulfilled by default values.

2.1.3. What is a Cruise?

A cruise is a scientific journey made on one identified ship and normally, has been reported in a ROSCOP summary report at ICES and the World Data Centres. For recent cruises, this is in general not a problem, but for historical cruises poorly documented and for coastal stations that may be not easy to determine the cruises.
When reconstructing a cruise from a compilation of historical data sets, the following recommendations have to be followed:

1. A compilation of historical stations can be identified as a virtual cruise, if they have been collected on board the same vessel. In that case it is possible to reconstruct the ship track for further checks.
2. The cruise duration should not exceed one year. If this were the case, it is better to split the cruise into different legs between calls into ports. But it is not necessary to cut a cruise at the 31st of December.

3. The usual number of profiles of the same type made is between 10 and 200, and the processing software is adapted to this order of magnitude.
4. In case of coastal repeated stations made with different ships, (not always identified), it is possible to identify the cruise by "Station X - year YYYY " or "Station X - Month YYYY"

Recommendation 1 and 4 are important. Recommendation 2 and 3 can be slightly adjusted depending on the context:

- If the cruise duration is 370 days (long sections), it is not necessary to split it for 3 stations out of the year
- If the cruise file include 220 stations, that remains also manageable, but 800 is not.

2.1.3.1. Cruise and Station Identifiers

The method to avoid the duplicates is to have a unique reference system. The cruise names are not a sufficient system, because the spelling varies frequently and those two laboratories can give the same name to different cruises. For that reason, each cruise is referenced by both a cruise name given by the source laboratory and a MEDAR identifier. This identifier is repeated in each profile identifier.

2.1.3.2. Cruise reference

The cruise reference is composed of 13 characters and begins with two codes (data centre code and country code) from the table given in 3.4. The complete description is given here below**. No blank is allowed in the reference,** '0' must replace them if any.

Length	Type	Description
2	Char	Data Centre Code in charge of the dataset
2	Char	Country code of the source laboratory
4	Number	Year of the beginning of the cruise : format YYYY
5	Char	Serial number, either from the source or given by the data centre

Example:

```
FI35199706008
```

2.1.3.3. Profile Reference

Each profile is referenced unambiguously in the following way:
cruise reference code + the original station number from the field experiment + the cast number.(total 18 characters)

Length	Type	Description
13	Char	Cruise reference to which the station belongs
4	Char	Station number
1	Char	Cast - This can be used as a fifth character for the station number or as a character to describe the cast of one station if several casts are performed as the same location

No blank is allowed in the station numbers, '0' must replace them if any.

Example :

```
FI3519970600800011
```

2.2. Cruise Summary Format

2.2.1. Description

BP = Beginning Position, **SL** = string length, **NDT**= Number of data types (ROSCOP)
NCO = Number of comment lines (textual information on the cruise)
M=Mandatory **NB**=No Blank **O**=Optional

LINE	FIELD	DESCRIPTION	BP	SL	TYPE	
1	1st character	*	1	1	char	M
	cruise id.	MEDATLAS reference	2	13	char	M
	cruise name	originator cruise name/ref.	16	32	char	M
	ship code	standardised WDCA/ICES/IOC code	49	4	char	M
	ship name	full ship name	54	25	char	M
2	start date	DD/MM/YYYY	1	10	char	M
	end date	DD/MM/YYYY	12	10	char	M
	region name	GF3 table	23	35	char	M
3	country code	Source laboratory country code	1	2	char	M
	address	Laboratory, institution, town	4	75	char	NB
4	name	chief scientist full name	1	40	char	NB
	key word	'Project='	42	8	char	M
	project	name of the project	50	28	char	O
5	key	'Regional Archiving='	1	19	char	O
	data centre	regional archiving centre code	21	2	char	M
	key word	'Availability='	42	13	char	O
	availability	Data confidentiality code (P/L/C)	55	1	char	O
5+1	key word	'Data Type='	1	10	char	M
	ROSCOP code	ROSCOP code of the data type	11	3	char	M
TO	key word	'n='	15	2	char	M
	number	number of profiles for the type	17	4	num	M
5+NDT	key word	'QC='	22	3	char	M
	QC	Y/N (Yes or No)	25	1	char	M
6+NDT	key word	'COMMENT'	1	7	char	O
5+NDT+NCO	key word	any other cruise information	1	80	char	O

Important:

- **Only the first line of the cruise header begins with a '" * ".**
- If the originator cruise name is mission, find an appropriate cruise name ex SHIP NAME YEAR or repeat the reference
- Ship codes are given by ICES; codes already existing are on the server:
  www.ices.dk/ocean/codes/ship98.htm
  if not exists, request one to: *susanne@ices.dk*
- The region is from the IHB nomenclature, country codes, ship codes and ship names, confidentiality and ROSCOP codes should follow strictly the codes given in §3.
- For the codes, see §3
- NB request to be filled with "UNKNOWN" if no information available
- The number of lines with ROSCOP codes is not limited, but should include the code of the file data type and the number behind is the number of this type of profiles
- After "COMMENT" it is possible to include as many comment lines as useful, especially to keep information of the sensor types etc.
- The original file name should be keep in the comments

2.2.2. Example of Cruise header

```
*IO48197979013 ASCOP 1 (ITT)                    48B1 BANNOCK
29/10/1979-09/11/1979 ADRIATIC SEA
48 ISTITUTO TALASSOGRAFICO, TRIESTE
BREGANT Davide                          Project=ASCOP
Regional Archiving= IO                  Availability=P
Data Type=H09 n=23   QC=Y
Data Type=H21 n=23   QC=Y
Data Type=H22 n=23   QC=Y
Data Type=H24 n=23   QC=Y
Data Type=H25 n=23   QC=N
Data Type=H26 n=23   QC=Y
Data Type=H27 n=23   QC=N
Data Type=H28 n=23   QC=N
Data Type=H76 n=0    QC=N
Data Type=P01 n=0    QC=N
Data Type=B02 n=23   QC=N
COMMENT
DM=TEMP and PSAL controlled with MODB climatological values
```

2.3. Profile Format - Header

2.3.1. Description

The information in the first lines like the station identifier, date, time, location, list of observed parameters and units is mandatory. The environmental information on the observations can by archived either behind « *DC= » (for Data collection) is optional

The first observed parameter is the reference :

- pressure in decibar for the observations in the water
- depth (in meters) below the bottom for sediment observations

2.3.1.1. First character of the header lines

All the lines begin with the character « * ».

2.3.1.2. Latitude and Longitude

In order to avoid ambiguity, N/S and E/W will be specified for latitude and longitude instead of signs.

2.3.1.3. Missing information

Missing time should be assigned to '9999' and "TIME IS UNKNOWN" added in comment line.
Other missing information (when optional) in character strings: 'X' as many times as the missing string length or 'UNKNOWN' or ‘9’ for numerical values (like bottom depth).

2.3.1.4. Parameters List

The first observed parameter is the reference, which for vertical profiles must be the pressure in decibar.
The list of each observed parameter (pressure, temperature, salinity, nutrients) include the parameter (extended) GF3 code, name, unit (International System) and default value. A different unit corresponds to a different parameter code.

2.3.1.5. History and information on the data processing

In order to maintain some flexibility with the format and not to loose existing complementary information on the data processing, meteorological observations etc. not taken into account in the format, three specific fields terminate each header profile:
*DC HISTORY for the information linked to the data collection at sea (like instrument, calibration)
*DM HISTORY for the information linked to the data management and archiving (like the source latitude if the sign or the value has been changed)
*COMMENT for all optional data and meta data like time and location at the end of the profile, meteorological observations.
Do not repeat keywords (ex use EDATE=, ETIME= ELAT=, ELON=, EDEPTH and not DATE, TIME, LAT, LON, DEPTH) to specify the end date, time, latitude, longitude and bottom depth of a station. The number of *COMMENT lines is not limited. All the meteorological information and the information behind the comment lines (end of the station, secchi disk, meteorological observations) is optional, but to access them easily, it is better to use GF3 codes as keywords (3.6)

2.3.1.6. Last line

The last line begins with the character « * » and the parameter GF3 codes as titles of the columns of observations. They should be the same as the list.

NP = number of observed parameters incl. the reference (pressure); **BP** =Beginning Position
NCO = number of comment lines in the header; **SL** = string length

LINE	FIELD	DESCRIPTION	BP	SL	TYPE	
1	start character *		1	1	char	**M**
	reference	MEDATLAS ref. (cruise+station+cast)	2	18	char	**M**
	key word	'Data Type='	21	10	char	**M**
	data type	ROSCOP code	31	3	char	**M**
2	date	'*DATE=', DDMMYYYY	1	14	char	**M**
	time	'TIME=',HHMN	16	9	char	**NB**
	latitude N/S	'LAT=', N or S	26	5	char	**M**
	lat. degrees	latitude degrees (0 to 90)	31	2	char	**M**
	lat. minutes	latitude minutes.hundredth	34	5	char	**M**
	longitude E/W	'LON=', E or W	40	5	char	**M**
	long. degrees	longitude degrees (0 to 180)	45	3	char	**M**
	long. minutes	minutes.hundredth	49	5	char	**M**
	key word	'DEPTH='	55	6	char	**NB**
	bottom depth	bottom depth in metres	61	6	num	**M**
	key word	'QC='	68	3	char	**M**
	time flag	QC flag on date and time	71	1	num	**M**
	lat. flag	QC flag on latitude	72	1	num	**M**
	long. flag	QC flag on longitude	73	1	num	**M**
	depth flag	QC flag on bottom depth	74	1	num	**M**
3	key word	'*NB PARAMETERS= '	1	15	char	**M**
	nb. of columns	number of measured parameters (NP)	16	2	num	**M**
	key word	'RECORD LINES='	19	13	char	**M**
	number of lines	number of observations records (NL)	32	5	num	**M**
4	1st character	'*'	1	1	char	**M**
	title column p	GF3 code for parameter p	2	4	char	**M**
TO	parameter p	parameter full name (IOC def.)	7	30	char	**M**
	unit p	('IS/IOC unit')	37	30	char	**M**
3+NP	key word	'def.='	68	5	char	**M**
	default val.	string of '9'.string of '9' same format as the parameter p	73	nlen(np)	num	**M**
4+NP	key word	'*GLOBAL PROFILE QUALITY FLAG='	1	29	char	**M**
	profile QC	global quality flag value	30	1	num	**M**
	key word	'GLOBAL PARAMETERS QC FLAGS='	32	27	char	**M**
	profile QC	global Q flags for parameter N	50	N	num	**M**
5+NP	collect hist.1	'*DC HISTORY='method, instrum. etc	1	80	char	**O**
6+NP	collect hist.2	'*', continuation	1	80	char	**O**
7+NP	archv. hist.1	'*DM HISTORY', data mangt. history	1	80	char	**O**
8+NP	archv. hist.2	'*', end of data management	1	80	char	**O**
9+NP	comment 1	'*COMMENT ', first comment line	1	80	char	**O**
10+NP	comment 2	'*' optional information 'EDATE=',	1	15	char	**O**
		'ETIME=',HHMN	17	10	char	**O**
		'ELAT=', N or S	28	5	char	**O**
	.....	latitude degrees (0 to 90)	34	2	char	**O**
	.....	latitude minutes.hundredth	37	5	char	**O**
	.....	'ELON=', E or W	43	5	char	**O**
	.....	longitude degrees (0 to 180)	49	3	char	**O**
	.....	minutes.hundredth	52	5	char	**O**
	.....	'EDEPTH='	59	6	char	**O**
	.....	bottom depth in metres	66	6	num	**O**
TO	comment n	'*SECCHI DISK='	1	80	char	**O**
	comment n	'*' any other information to archive	1	80	char	**O**
8+NP+NCO	comment	'*', last comment line	1	80	char	**O**
9+NP+NCO	surface obs. 1	'*SURFACE SAMPLES=', samples	1	80	char	**O**
10+NP+NCO	surface obs. 2	'*', continuation	1	80	char	**O**
LAST	start character	*	1	1	char	**M**
	title 1	'PRES' or ref. parameter	2	4	char	**M**
	separator	blank	6	nlen(1)-4	blank	**M**
	title 2	GF3 code parameter 2	bp(2)	4	char	**M**
	separator		bp(p-1)+4	nlen(p-1)-3		**M**
	title par. P	GF3 code parameter p	bp(p)	4	char	**M**
	title NP	GF3 code parameter NP	bp(np)	4	char	

2.3.2. Example of Profile Header

```
*IO4819797901300070 Data Type=H09
*DATE=02111979 TIME=1125 LAT=N45 16.90 LON=E 13 16.00 DEPTH=    31 QC=1111
*NB PARAMETERS=14 RECORD LINES=00005
*PRES SEA PRESSURE sea surface=0    (decibar=10000 pascals)        def.=-999.9
*TEMP SEA TEMPERATURE               (Celsius degree)               def.=99.999
*PSAL PRACTICAL SALINITY            (P.S.U.)                       def.=99.999
*DOX1 DISSOLVED OXYGEN              (ml/l)                         def.=99.99
*NTRA NITRATE (NO3-N) CONTENT       (millimole/m3)                 def.=99.99
*NTRI NITRITE (NO2-N) CONTENT       (millimole/m3)                 def.=99.99
*AMON AMMONIUM (NH4-N) CONTENT      (millimole/m3)                 def.=99.99
*PHOS PHOSPHATE (PO4-P) CONTENT     (millimole/m3)                 def.=99.999
*SLCA SILICATE (SIO4-SI) CONTENT    (millimole/m3)                 def.=99.99
*PHPH PH                            (PH unit)                      def.=99.999
*ALKY ALKALINITY                    (millimole/m3)                 def.=99.999
*TSMP TOTAL SUSPENDED MATTER        (gram/m3)                      def.=99.999
*CPHL CHLOROPHYLL-A TOTAL           (milligram/m3)                 def.=999.99
*PHTP TOTAL PHEOPHYTINE             (milligram/m3)                 def.=999.99
*GLOBAL PROFILE QUALITY FLAG=1 GLOBAL PARAMETER QC FLAGS=11111091100900
*DC HISTORY=
*
*DM HISTORY=
*
*COMMENT   =
*Data were received with depth as reference, assimilated as pressure.
*DRYT= 14.0 WETT= 11.5 RELH=75 ATMS=1020.0 CLDT=6 CLDA=7 VISI=7 WWCD=2 RDIN= 999
*WSPD= 2 WDIR=36 SECC= 7 VEST=  VDIR=36 VPER=  SEAS=2
*
*SURFACE SAMPLES=
*
*PRES  TEMP   PSAL   DOX1  NTRA  NTRI  AMON  PHOS   SLCA  PHPH   ALKY   TSMP   CPHL   PHTP
```

2.4. Profile Format Description - Data Points

2.4.1. Description

2.4.1.1. First column

Pressure must be the reference co-ordinate (first column) of the vertical profiles. When the pressure is not explicitly defined (mainly the oldest historical data sets which may have the depth measurements instead), the vertical co-ordinate is supposed to be pressure in decibars (which makes no significant differences on historical data).
The reference parameter (pressure) must be recorded in strictly increasing order.

2.4.1.2. Columns length

Each parameter **p** can have any length **nlen(p)**, but this length must be constant in the profile, and the decimal points at a constant position. The separators are blanks of one character (or more), after each parameter value. The quality flags are grouped after the last separator, with no blank between them. Therefore if a total of **NP** parameters are recorded, the beginning positions of parameter p (**bp(p)**) and its quality flag (**bpq(p**)) in the record lines are:

bp(p)=nlen(1)+ ..+ nlen(p-1) + p-1
bpq(p)= bp(NP) + nlen(NP) + p

nlen(p) includes the blanks separator(s) for the parameter p.

For missing data, the default characters are in numbers: 9 or -9 at the same format and length as the expected numbers. The number of decimals must implicitly indicate the accuracy of the measurements and not exceed the resolution.

2.4.1.3. Last line

The last line of a station is completed with default values.

NL=number of records lines **BP** =Beginning Position, **SL** = string length

LINE	FIELD	DESCRIPTION	BP	SL	TYPE	
1	parameter 1	parameter 1 in IS units	1	nlen(1)	num	**M**
	separator	blank	bp(2)-1	1		**M**
to	parameter 2	parameter 2 in IS units	bp(2)	nlen(2)	num	**M**
NL	separator	blank	bp(np)-1	1		**M**
	parameter NP	parameter NP in IS units	bp(np)	nlen(np)	num	**M**
	separator	blank	bp(q1)-1	1		**M**
	QC Flag 1	Quality Flag parameter 1	bp(q1)	1	num	**M**
	QC Flag NP	Quality Flag parameter NP	bp(q1)+np	1	num	**M**
NL+1	def. val. par.1	'-999.9' or string of '9'	1	nlen(1)	num	**M**
(Last	**+** separator	blank	bp(2)-1	1		**M**
line	def. val. par.2	string of '9'as in header	bp(2)	nlen(2)	num	**M**
of the	def. val. par.NP	string of '9'as in header	bp(NP)	nlen(NP)	num	**M**
profile)	separator	blank	bp(q1)-1	1		**M**
	QC Flag 1	'9' (Def. val.Quality Flag)	bp(q1)	1	num	**M**
	QC Flag NP	'9' (Def. val.Quality Flag)	bp(q1)+np	1	num	**M**

2.4.2. Example of data points records

```
   0.0 16.809 36.361  5.35   .00   .02 99.99   .034   .28  8.290  2.739 99.999   2.35   1.68 11111091100900
   5.0 16.711 36.498  5.42   .06   .06 99.99   .185   .80  8.330  2.751 99.999   2.25   1.99 11111091100900
  10.0 17.685 37.912  4.17  1.55  1.03 99.99   .307  8.86  8.200  2.729 99.999    .44    .56 11111091100900
  20.0 17.547 38.049  4.10  1.60  1.15 99.99   .269  9.11  8.200  2.729 99.999    .27    .49 11111091100900
  29.0 17.348 38.066  3.91  2.31  1.25 99.99   .494 10.85  8.180  2.721 99.999    .20    .35 11111091100900
-999.9 99.999 99.999 99.99 99.99 99.99 99.99 99.999 99.99 99.999 99.999 99.999 999.99 999.99 99999999999999
```

2.5. Example of a begining of the file with cruise header, station header and data points

```
*IO48197979013 ASCOP 1 (ITT)                    48B1 BANNOCK
29/10/1979-09/11/1979 ADRIATIC SEA
48 ISTITUTO TALASSOGRAFICO, TRIESTE
BREGANT Davide                          Project=ASCOP
Regional Archiving= IO                  Availability=P
Data Type=H09 n=23   QC=Y
Data Type=H21 n=23   QC=Y
Data Type=H22 n=23   QC=Y
Data Type=H24 n=23   QC=Y
Data Type=H25 n=23   QC=N
Data Type=H26 n=23   QC=Y
Data Type=H27 n=23   QC=N
Data Type=H28 n=23   QC=N
Data Type=H76 n=0    QC=N
Data Type=P01 n=0    QC=N
Data Type=B02 n=23   QC=N
COMMENT
DM=TEMP and PSAL controlled with MODB climatological values
*IO48197979013OO070 Data Type=H09
*DATE=02111979 TIME=1125 LAT=N45 16.90 LON=E 13 16.00 DEPTH=    31 QC=1111
*NB PARAMETERS=14 RECORD LINES=00005
*PRES SEA PRESSURE sea surface=0    (decibar=10000 pascals)        def.=-999.9
*TEMP SEA TEMPERATURE               (Celsius degree)               def.=99.999
*PSAL PRACTICAL SALINITY            (P.S.U.)                       def.=99.999
*DOX1 DISSOLVED OXYGEN              (ml/l)                         def.=99.99
*NTRA NITRATE (NO3-N) CONTENT       (millimole/m3)                 def.=99.99
*NTRI NITRITE (NO2-N) CONTENT       (millimole/m3)                 def.=99.99
*AMON AMMONIUM (NH4-N) CONTENT      (millimole/m3)                 def.=99.99
*PHOS PHOSPHATE (PO4-P) CONTENT     (millimole/m3)                 def.=99.999
*SLCA SILICATE (SIO4-SI) CONTENT    (millimole/m3)                 def.=99.99
*PHPH PH                            (PH unit)                      def.=99.999
*ALKY ALKALINITY                    (millimole/m3)                 def.=99.999
*TSMP TOTAL SUSPENDED MATTER        (gram/m3)                      def.=99.999
*CPHL CHLOROPHYLL-A TOTAL           (milligram/m3)                 def.=999.99
*PHTP TOTAL PHEOPHYTINE             (milligram/m3)                 def.=999.99
*GLOBAL PROFILE QUALITY FLAG=1 GLOBAL PARAMETER QC FLAGS=11111091100900
*DC HISTORY=
*
*DM HISTORY=
*
*COMMENT   =
*Data were received with depth as reference, assimilated as pressure.
*DRYT= 14.0 WETT= 11.5 RELH=75 ATMS=1020.0 CLDT=6 CLDA=7 VISI=7 WWCD=2 RDIN= 999
*WSPD= 2 WDIR=36 SECC= 7 VEST=  VDIR=36 VPER=  SEAS=2
*
```

```
*SURFACE SAMPLES=
*
*PRES  TEMP    PSAL    DOX1  NTRA  NTRI  AMON  PHOS   SLCA  PHPH   ALKY   TSMP   CPHL   PHTP
    .0 16.809 36.361  5.35   .00   .02 99.99   .034   .28  8.290  2.739 99.999   2.35   1.68 11111091100900
   5.0 16.711 36.498  5.42   .06   .06 99.99   .185   .80  8.330  2.751 99.999   2.25   1.99 11111091100900
  10.0 17.685 37.912  4.17  1.55  1.03 99.99   .307  8.86  8.200  2.729 99.999    .44    .56 11111091100900
  20.0 17.547 38.049  4.10  1.60  1.15 99.99   .269  9.11  8.200  2.729 99.999    .27    .49 11111091100900
  29.0 17.348 38.066  3.91  2.31  1.25 99.99   .494 10.85  8.180  2.721 99.999    .20    .35 11111091100900
-999.9 99.999 99.999 99.99 99.99 99.99 99.99 99.999 99.99 99.999 99.999 99.999 999.99 999.99 99999999999999
*IO4819797901300050 Data Type=H09
*DATE=02111979 TIME=1257 LAT=N45 18.40 LON=E 13  7.60 DEPTH=    31 QC=1111
*NB PARAMETERS=14 RECORD LINES=00005
*PRES SEA PRESSURE sea surface=0    (decibar=10000 pascals)        def.=-999.9
*TEMP SEA TEMPERATURE              (Celsius degree)               def.=99.999
*PSAL PRACTICAL SALINITY           (P.S.U.)                       def.=99.999
*DOX1 DISSOLVED OXYGEN             (ml/l)                         def.=99.99
*NTRA NITRATE (NO3-N) CONTENT      (millimole/m3)                 def.=99.99
*NTRI NITRITE (NO2-N) CONTENT      (millimole/m3)                 def.=99.99
*AMON AMMONIUM (NH4-N) CONTENT     (millimole/m3)                 def.=99.99
*PHOS PHOSPHATE (PO4-P) CONTENT    (millimole/m3)                 def.=99.999
*SLCA SILICATE (SIO4-SI) CONTENT   (millimole/m3)                 def.=99.99
*PHPH PH                           (PH unit)                      def.=99.999
*ALKY ALKALINITY                   (millimole/m3)                 def.=99.999
*TSMP TOTAL SUSPENDED MATTER       (gram/m3)                      def.=99.999
*CPHL CHLOROPHYLL-A TOTAL          (milligram/m3)                 def.=999.99
*PHTP TOTAL PHEOPHYTINE            (milligram/m3)                 def.=999.99
*GLOBAL PROFILE QUALITY FLAG=1 GLOBAL PARAMETER QC FLAGS=11111091100900
*DC HISTORY=
*
*DM HISTORY=
*
*COMMENT   =
*Data were received with depth as reference, assimilated as pressure.
*DRYT= 14.5 WETT= 11.0 RELH=67 ATMS=1019.5 CLDT=6 CLDA=8 VISI=7 WWCD=2 RDIN= 999
*WSPD= 2 WDIR=03 SECC= 6 VEST=  VDIR=03 VPER=  SEAS=3
*
*SURFACE SAMPLES=
*
*PRES  TEMP    PSAL    DOX1  NTRA  NTRI  AMON  PHOS   SLCA  PHPH   ALKY   TSMP   CPHL   PHTP
    .0 16.582 36.428  5.49   .00   .01 99.99   .029   .23  8.330  2.754 99.999   2.52   1.80 11111091100900
   5.0 16.685 36.524  5.32   .00   .00 99.99   .099  1.68  8.290  2.735 99.999 999.99 999.99 11111091100999
  10.0 17.240 37.613  5.13   .25   .18 99.99   .077  4.43  8.270  2.743 99.999   1.36   1.08 11111091100900
  20.0 17.224 38.088  4.05  2.03   .82 99.99   .450 10.29  8.170  2.715 99.999    .51    .56 11111091100900
  29.0 16.565 38.081  3.75  2.95   .75 99.99   .334 14.05  8.170  2.725 99.999    .22    .33 11111091100900
-999.9 99.999 99.999 99.99 99.99 99.99 99.99 99.999 99.99 99.999 99.999 99.999 999.99 999.99 99999999999999
```

3. CODES

Codes are used in the database when the information (meta-data) is frequently exchanged, and as selection criteria. The codes may be internal to the MEDATLAS format, or international (IOC/GF3, ICES). The format is strict about the codes which are checked in the databases.
The different code table are:

1. Countries (GF3)
2. IHB for the Mediterranean and Black Sea
3. Ship (ICES)
4. Oceanographic data centres and corresponding prefix for cruise identifier
5. ROSCOP codes for generic data types
6. Extended GF3 parameter codes & units
7. Quality flags
8. Data sets Availability

The international codes are available at ICES:http://www.ices.dk/ocean/
The specific MEDAR codes can be accessed at the coordinating web site:
http://www.ifremer.fr:/medar/formats.htm

3.1. IOC/GF3 COUNTRY CODES

72 Albania	AL Algeria	10 Austria
11 Belgium	15 Bulgaria	HR Croatia
95 Croatia/FY	CY Cyprus	26 Denmark
27 Egypt	35 France	06 Germany
36 Greece	47 Israel	48 Italy
49 Japan	52 Lebanon	ML Malta
MO Monaco	56 Morocco	64 Netherlands
58 Norway	68 Portugal	73 Romania
RU Russia	90 FSU	91 South Africa
29 Spain	77 Sweden	88 Tunisia
89 Turkey	UR Ukraine	74 United Kingdom
31 USA	32 USA	33 USA
99 Unknown/ Unspecified		

Full list at ICES:http://www.ices.dk/ocean/codes/country.htm

3.2. OCEANOGRAPHIC MEDITERRANEAN REGIONS

(from the International Hydrographic Bureau definitions)

MEDITERRANEAN SEA	MED., EASTERN BASIN
MED. WESTERN BASIN	IONIAN SEA
GIBRALTAR STRAIT	ADRIATIC SEA
ALBORAN SEA	AEGEAN SEA
BALEARIC SEA	BLACK SEA
LIGURIAN SEA	SEA OF MARMARA
TYRRHENIAN SEA	SEA OF AZOV

3.3. Ship Codes

The international ship code and name list is available on the ICES web site:
http://www.ices.dk/ocean/codes/ship98.htm
If the ships are not referenced in the table, new codes have to be requested to ICES:
susanne@ices.dk

3.4. COUNTRY AND DATA CENTRES OF MEDAR DATA BASE

COUNTRY	**CC GF3 Code**	**DC MEDAR Code**	**DATA CENTRE**	**Prefix of Cruise Id.**
Algeria	AL	AI	ISMAL	AIAL
Belgium	11	BG	Universite de Liege, GHER	BG11
Bulgaria	15	BM	National Institute Meteorology and Hydrology, NIMH	BM15
Croatia	HR	IF	Institute of Oceanography & Fisheries, Split	IFHR
Cyprus	CY	CN	Agriculture Natural Res. Fisheries Dept., CyNODC	CNCY
Denmark	26	DI	ICES	DI26
Egypt	27	EN	National Institute Oceanography Fisheries, ENODC	EN27
France	35	FI	IFREMER/SISMER	FI35
France	35	FS	SHOM	FS35
Georgia	GE	NO	National POceanographic Centre, Tbilisi	NOGE
Germany	06	AD	Deutsches Ozeanopraphisches Datenzentrum	AD06
Greece	36	GN	NCMR/HNODC	GN36
Israel	47	IL	IOLR	IL47
Italy	48	IE	ENEA	IE48
Italy	48	II	IRPEM	II48
Italy	48	IO	OGS/DOGA	IO48
Lebanon	52	LB	NCSR, National Centre for Marine Sciences	LB52
Malta	ML	ML	University of Malta, Physical Oceanography Unit	MLML
Morocco	56	MI	Institut National de Recherche Halieutique, DOTM	MI56
Russia/FSU	90	WB	RIHMI-WDCB	WB90
Spain	29	SB	Balearic Islands University, UIB	SB29

Spain	29	SI	IEO	SI29
Tunisia	88	TU	INSTM	TU88
Turkey	89	TN	Turkish Navy Hydrographic Service, DNHO	TN89
Ukraine	UR	UM	Marine Hydrophysical Institute, MIST	UMUR
United Kingdom	74	UB	British Oceanographic Data Center	UB74
United States of America	31	WA	NOAA-WDCA	WA31

3.5. ROSCOP Codes for the main types of observations

These general codes are related to an instrument and are used in the cruise header where several types of observations can be listed. The most frequent related to hydrographic cruises, and that describe the archived profiles are the following:

ROSCOP MOST FREQUENT TYPES OF OBSERVATIONS
CODE

B01	Primary productivity
B02	Phytoplankton pigments (eg chlorophyll)
B06	Dissolved organic matter (inc DOC)
H09	Water bottle stations
H10	CTD stations
H11	Subsurface meas. underway (T,S)
H13	Bathythermograph
H16	Transparency (eg transmissometer)
H17	Optics (eg underwater light levels)
H21	Oxygen
H22	Phosphate
H23	Total - P
H24	Nitrate
H25	Nitrite
H26	Silicate
H27	Alkalinity
H28	pH
H30	Trace elements
H31	Radioactivity
H32	Isotopes
H33	Other dissolved gases
H71	Surface measurements underway (T,S)
H72	Thermistor chain
H73	Geochemical tracers (eg freons)
H74	Carbon dioxide
H75	Total - N
H76	Ammonia
H80	Hydrographic atlas data
H90	Other chemical oceanographic meas.

The full Multidisciplinary ROSCOP Codes list is available at ICES:
http://www.ices.dk/ocean/roscop/par-cod.htm

3.6. Parameter codes

These codes are defined from GF3 tables, corresponding to observations made with the International System. A derived code is used for historical data when this has not has not been the case and that the conversion is not directly possible.

CODE	NAME	UNIT
PRES	SEA PRESSURE sea surface=0	decibar=10000 pascals
TEMP	SEA TEMPERATURE	Celsius degree
PSAL	PRACTICAL SALINITY	P.S.U.
DOXY	DISSOLVED OXYGEN	millimole/m3
DOX1	DISSOLVED OXYGEN	ml/l
DOX2	DISSOLVED OXYGEN	micromole/kg
NTRA	NITRATE (NO3-N) CONTENT	millimole/m3
NTRI	NITRITE (NO2-N) CONTENT	millimole/m3
NTRZ	NITRATE + NITRITE CONTENT	millimole/m3
NTOT	TOTAL DISSOLVED NITROGEN	millimole/m3
PHOS	PHOSPHATE (PO4-P) CONTENT	millimole/m3
TPHS	TOTAL PHOSPHORUS (P)	millimole/m3
SLCA	SILICATE (SIO4-SI) CONTENT	millimole/m3
ALKY	ALKALINITY	millimole/m3
PHPH	PH	pH unit
HSUL	HYDROGEN SULPHIDE (H2S)	millimoles/m3
CPHL	CHLOROPHYLL-A TOTAL	milligram/m3
AMON	AMMONIUM (NH4-N) CONTENT	millimole/m3

Historical data sets non corrected for change of salinity definition

SSAL	SALINITY (PRE-1978 DEFN)	P.S.U.

If additional parameter are observed, they are safeguarded within the file. A list of the extended GF3 codes already archived in other programmes is available at:

http://www.ifremer.fr:/medar/htql/liste_param.htql

3.7. Quality Flags

CODE	MEANING
0	NOT CONTROLLED VALUE
1	CORRECT VALUE
2	VALUE INCONSISTENT WITH STATISTICS (Out of narrow range limits)
3	DUBIOUS VALUE (SPIKE)
4	FALSE VALUE (Out of broad range regional limits, or corresponding to a vertical unstability ..)
5	VALUE MODIFIED DURING QC (only for obvious location or time errors)
6-8	Not used
9	NO OBSERVED VALUE

3.8. Confidentiality Codes

CODE	SIGNIFICATION
P	PUBLIC DOMAIN DATA
L	LIMITED ACCESS TO DATA (PROJECT ONLY)
C	CONFIDENTIAL DATA (SUBMITTED TO CHIEF SCIENTIST PERMISSION)

4. QUALITY CHECKS

4.1. Objectives and General Description

In conformity with the UNESCO/IOC and MAST recommendations, the QC includes automatic and visual procedures. Theses checks are performed on each profile separately and also on profiles grouped by cruises. The result of QC is to add a quality flag to each numerical value, but the values of the observations are not modified. In case of outlier on recent data sets, the originator is contacted to validate/correct/eliminate the value.

The principle of the QC of any parameter is to compare the observations with the available statistics of the same parameter. These statistics vary from a region to another, and the checks are adjusted accordingly.

The chosen flag scale is simple and already used in other international projects. The flags are then validated or corrected manually, taking into account the overall coherence of the data within the cruise, which is somehow subjective but not arbitrary, and the remarks of the data originator. Using pre-existing knowledge on the region makes automatic checks: extreme values for broad range checks (corresponding to high error level), and previous climatological profiles for narrow range checks; there is also some subjectivity in the tuning of these parameters. Specific software is on UNIX (SCOOP) at SISMER and HNODC, which is described here below. It is expected not to get any flag different from In case of outlier, the originator, if available and known, will be contacted to see where is the problem and if the data point has to be corrected or rejected. An early data submission facilitates the QC.

4.2. Flag scale

The flag scale is the flag scale adopted by the IOC for the GTSPP International program of temperature exchange in real time. The flag value if documented, is proportional to the level of error. When the data are displayed on a screen for visual checks, a colour is assigned to each flag which are the following:

- 0: No QC
- 1: Correct
- 2: Inconsistent
- 3: Dubious
- 4: False
- 5: Modified

9: Missing value

4.3. Check of the format QC-0

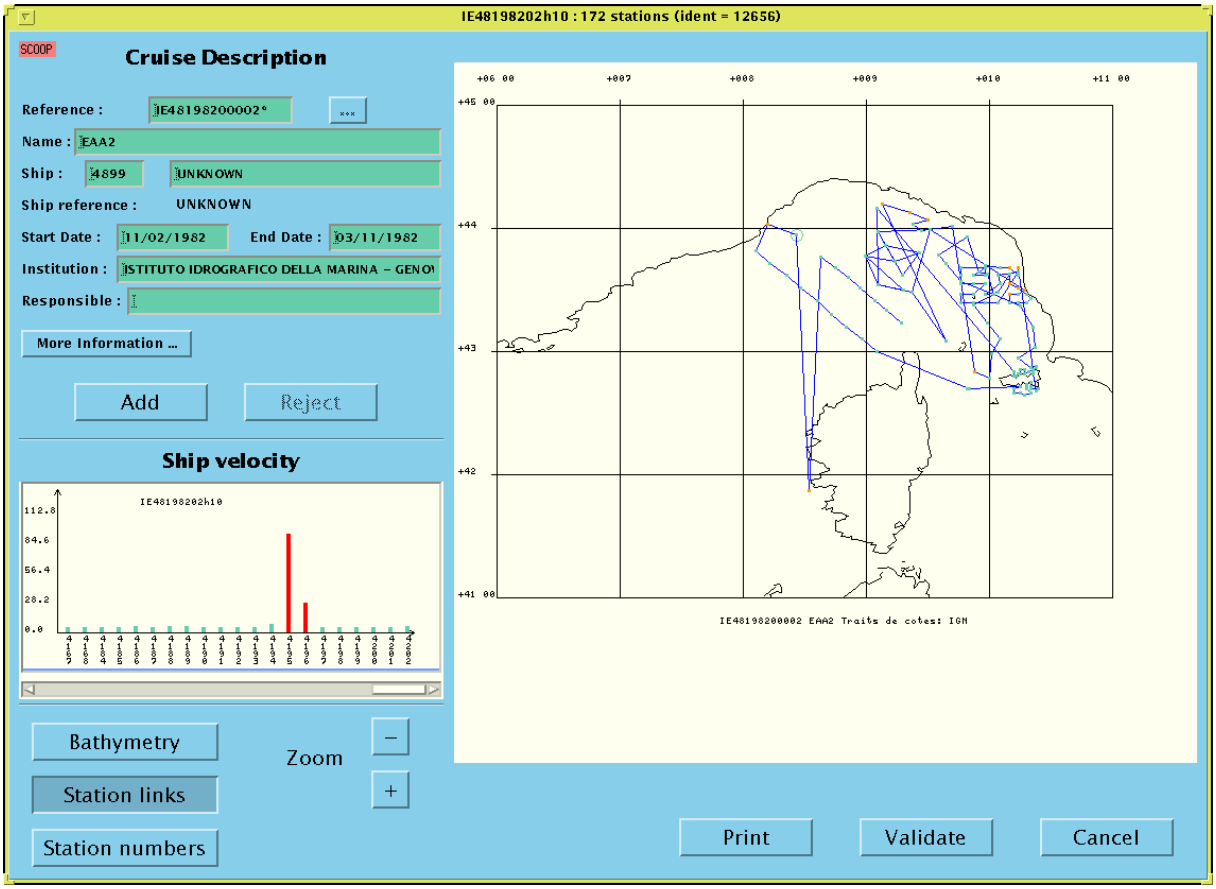
This check include the completeness of the documentation like ship name and code etc. Requested corrections or completion are made before any further control.

4.4. Check of he Headers: date and location QC-1

4.4.1. Check List and results

The following tests are performed automatically first and the results displayed on a screen to perform the manual check. As these checks concerns location and date, they may be followed with a correction (C) in case of obvious errors like sign errors or time assign to 24 hours. If this is not the case, the profile is eliminated (E) with a global flag to 4 (false) (C).

TEST		RESULT (If not E)	FLAG VALUE
1.1: Check for duplicates		E	
1.2: Check the date		C or E	→ 5
1.3: Check the ship velocity		C or E	→ 5
1.4: Check the location/shoreline		C or E	→ 5
1.5: Check the bottom sounding	(ETOPO5)		→ 2
no outlier			→ 1



1.6: Visualization and manual checks and validation of the flags

4.4.2. check for duplicates

4.4.2.1. duplicate cruises

This is one the main difficulty of the archiving and for which the cruise information is very important. The links between stations of the same cruise is used to compare with similar data sets. The check for duplicates includes:

- check for no pre-existing same cruise identifier
- check for cruises with same dates for beginning and end
- for same year, same country: visual check for superposed stations
- for each month, visual check of superposed stations (local position maps)

4.4.2.2. duplicate profiles

- automatic check for same profile identifiers
- automatic check for same stations positions (within 1 mile, 1 hour)
  within the same cruise
  out of the cruise
- visual check of the position maps of cruises having duplicate profiles

In case of duplicate: the *observed* data set is preferred to *reduced* (standard level) data set, or the most complete (or a combination), or the *latest* and the corresponding cruise summary

4.4.3. Check the date

- The day must be between 1 and the number of days of the month.
  The year of the profile must be the same as included in the cruise reference
  The month must be between 1 and 12
- The end of cruise must be later than the beginning
- The date and time of the profile must be within the cruise duration.

If this is not the case and the time flag = 4 (bad), the values are written in the DM history field of the header and an exit call for correction is made. Obvious errors like time= 24 hours are corrected with time=0 and day=day+1 flag=5. In this case the new calculated ship velocity must be acceptable.

4.4.4. Check the ship velocity

- If the ship velocity > maximum velocity of the ship (default is 15 knots) between two consecutive profiles, find the erroneous data (date or location), copy it in the DM history field of the header, interpolate and flag= 5 (changed after QC) the modified

4.4.5. Check the bottom sounding

- If the bottom depth sounding DEPH is not reported flag=9 (missing value)
- If DEPH out of the regional scale flag= 4 (bad)
- If the sounding is within the minimum (- 20%) and maximum (+ 20%) of 9 reference values, the flag = 1 (good). If DEPH is outside this interval flag = 3 (questionable).

The references values are the ETOPO 5 gridded (5' x 5') bottom depth (4) at the station location and at the 8 nearest points.

4.4.6. Visualisation and manual controls for QC1

All the previous checks are reviewed:

- Check for position over the sea
- Check the ship velocity between the consecutive stations
- Check the bottom depth (mainly deep basin / shelf water)

In order to facilitate the QC, the following displayed on the computer screen:

- Cruise identifier and name (permanent) and complete headers
- Coastal lines and bathymetry ETOPO5 (4) and GEBCO (5)
- Stations locations (linked or not)

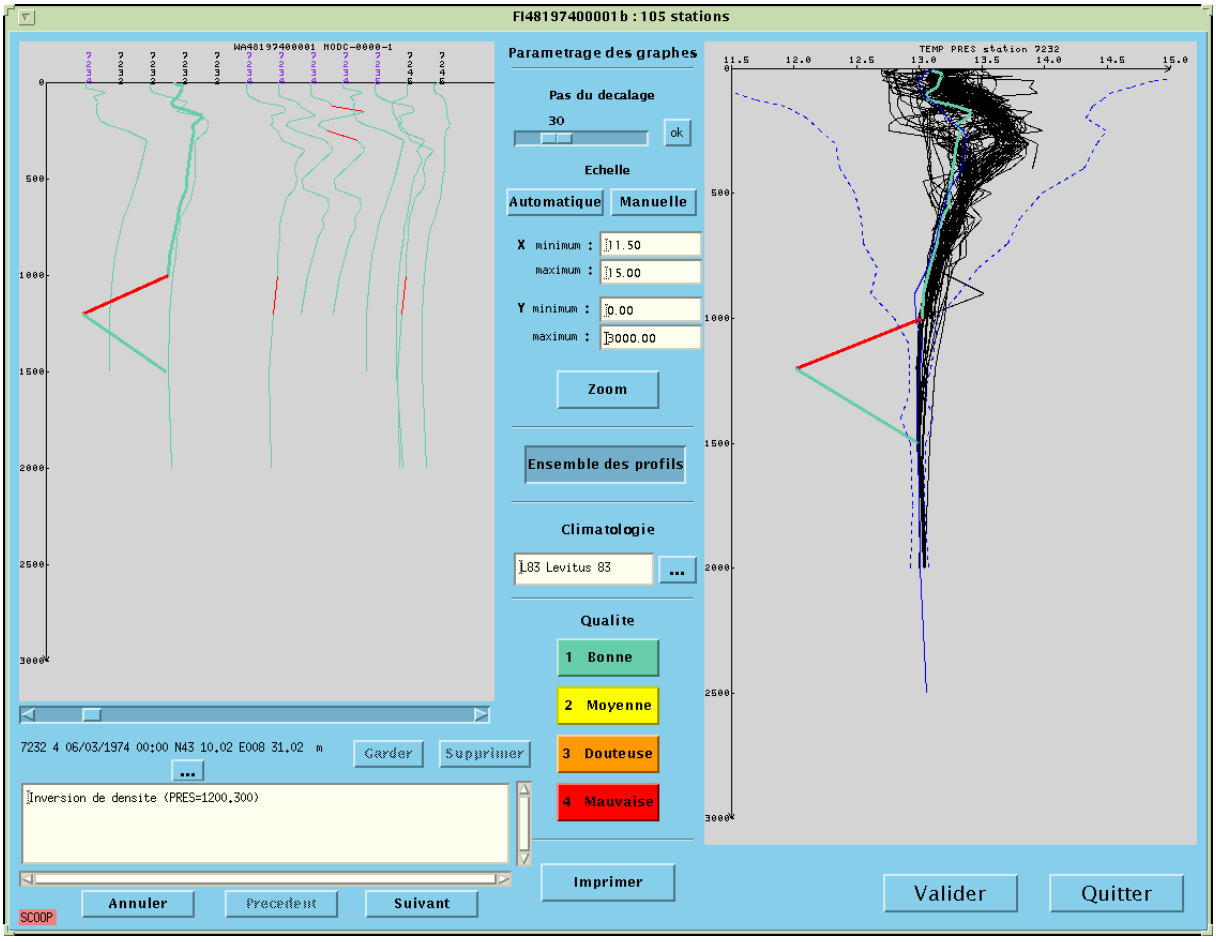
In case of necessity, the values and the DM history are modified. If it is not possible to get an acceptable date or position, global flag =4 (bad).

4.5. Check of the parameters - QC-2

4.5.1. Check List and results

These checks do not modify the observation but only add the quality flags.

TEST	RESULT FLAG	VALUE
2.1: Missing pressure	E	
2.2: Constant value on the vertical		→ 4
2.3: Impossible regional values (min & max.)		→ 4
2.4: Check for increasing reference (pressure)		→ 4
2.5: Data point below the bottom depth		→ 4
2.6: Check for spikes		→ 3
2.7: Compare with the pre-existing statistics (LEVITUS, MODB)		→ 2
2.8: Check the vertical stability		→ 4
no outlier	→ 1	
2.9: Visualisation and manual checks and validation of the flags		



4.5.2. Method

The higher severity checks are performed first, because there is no reason to perform for example narrow range checks, if a value is already out of the regional broad range scale. Only the vertical density check is performed at the end because it makes use of the results of the other checks and it is more difficult to implement (4 values are taken into account).
When a parameter is fully checked, a « global parameter flag » is attributed, depending on the percentage of flagged values (20%). It can be discussed if the number of values on the vertical, for examples profiles with less than 3 good levels the vertical, has to be taken into account to give the global flags. It has been chosen here not to attribute any quality index to this number, first because this test can be automatically recomputed, also because the interest of such « gappy » profiles depends on the potential further scientific analysis for example time series of coastal stations or deep sea geostrophic computations.

4.5.2.1. Check for acceptable data set

- The reference parameter must be present: SEARCH for PRES as a (GF3) column title (= vertical co-ordinate) If not present, the global profile flag = 4 (bad); GO TO the next profile.
- If PRES exists but no other parameters, the global profile flag = 4 (bad); GO TO the next profile.
- SEARCH for TEMP as a column title, but continue (with chemicals, temperature is not always recorded in the same file).

4.5.2.2. Check for increasing pressure

The reference parameter must be increasing

- If the pressure is not continuously increasing: flag = 4 (bad) for the first redundant data.
- If the complete profile is in the reverse order, EXIT to prepare it properly.

In the particular following cases, this check returns too many problematic data and the data are processed before further QC:
- the profile is in reverse order beginning from the bottom: it is transcended in increasing order;
- an important part is duplicated (the cast down of the CTD is interrupted to raise it a hundred meter before continuing the down cast): the first duplicated segments are rejected;
- if the profile includes more than one value per decibar, the values are filtered to about one decibar.

4.5.2.3. Check for constant profiles

A parameter cannot be constant on the vertical. If all the temperatures or all the salinities are constant then global profile quality flag =4 (bad) and " constant temperature" or "constant salinity" is written in the field "DM HISTORY" of the header.

data points flags = 4 (bad)

4.5.2.4. Check for impossible regional values

FOR each data, if the parameter is out of the regional scales (minimum and maximum), the data flag = 4 (bad). The deep layer and the upper layers can have different scales of variation.
These min-max values are adjusted on the vertical.

4.5.2.5. Check for spikes

This test is difficult and may be adjusted for continuous or discrete profiles. It requires at least 3 consecutive acceptable values. When selecting 3 consecutive acceptable values:

- If flag of the value = default value the value is not acceptable, take the following
- If flag of the value = 4 the value is not acceptable, take the following

Search the spiky values:
The IOC check is the following:
If (|V2-(V3+V1)/2 | - |V1-V3|/2) > THRESHOLD VALUE ---> flag (V2) = 3 (dubious)
However this test does not always work properly for data not regularly collected on the vertical, as it is often encompass with bottle casts. There are also difficulties with more than one value on the spike. In this case, a better algorithm to detect the spikes, taking into account the difference in gradients instead of the difference in values is:

$$| |(V2-V1)/(P2-P1)-(V3-V1)/(P3-P1)| - |(V3-V1)/(P3-P1)| |> \text{THRESHOLD VALUE}$$

In general the spike test requires manual validation.

4.5.2.6. Compare with the pre-existing statistics - check for pressure

The available reference statistics are the same as for the bottom depth sounding (ETOPO5):

- If the bottom depth sounding is recorded in the header and flag = 1(good)
  If PRES > sounding + 5% , flag = 4 (bad)
- If the bottom depth sounding is recorded in the header and flag = 2 (inconsistent with statistics)
  If PRES > sounding + 5% , flag = 3 (questionable)
- If bottom depth sounding is not recorded
  If PRES > the pressure must be within 0.5 and 2 times the reference statistics

if this is not the case, flag =3 (questionable)

4.5.2.7. Narrow range check for the data: Compare with the pre-existing climatological statistics

Comparing the data points with the existing statistics performs the narrow range check. The selection for he project is:

MEDATLAS 1997, for temperature and salinity, averaged on 1x1 square degree (6)

LEVITUS 1998, for nutrients

These statistical profiles are defined in a limited number of standard levels, and the automatic comparison is made by linearly interpolating them at the level of the observation. The allowed distance to the reference depends varies between respectively 3, 4 and 5 standard deviations, depending on the type of station: over the shelf (depth < 200 m), the slope and straits regions (200< depth < 400 m), the deep sea (> 400 m).

Procedure

- Select the nearest mean statistic profile of the same month (default same season, default same year) and the standard deviation
- Interpolate the reference profile and the standard deviation at the observed pressure level
- Recall the bottom sounding DEPH (default the ETOPO5 depth of the location) and compute the acceptable range of variation:
  If bottom DEPH <= 200 then range = 5 x standard deviation
  If bottom 200 < DEPH <= 400 then range = 4 x std. deviation
  If bottom 400 < DEPH then range = 3 x std. deviation
- Compute the absolute value of the difference between the data point and the (interpolated) reference at the same level. with this range:
  If difference > range then flag =2, else flag =1

4.5.2.8. Density inversion test

This test requires two consecutive acceptable levels of values. The automatic check is mainly used to assist the operator, the decision to flag one of the 4 values (temperature and salinity at the two levels) is always validated manually. A level of noise is attributed for the density.

- acceptable noise level for density:
  EPS= 0.03 (increased to 0.05 near the surface, in coastal areas for bottle sampling)
- selection of two consecutive acceptable level:
  if (pressure, temperature or salinity flag) = 4 or 9 the level is not acceptable
- compute the potential (unless deep density anomalies will be found) density anomaly from the equations of state of sea water (FOFONOFF and MILLARD, 1983 (9) and MILLERO and POISSON, 1981(10)) at each selected level:
  TETA= Potential temperature (PRES, TEMP, SAL, PRES0=0)
  D = density anomaly = sigma(PRES,TETA,PSAL)
- Perform the check each two consecutive densities:
  IF D2 + EPS > D1 then the stratification is stable, the temperature and salinity flags are unchanged
  IF D2 + EPS < D1 then the stratification is unstable
- In case of instability, find out which is the bad value: checks for other anomalies detected by previous checks at one of the two levels, and modify the flag to bad:
  IF FLAG(SAL1) > 1 MODIFY FLAG(SAL1) = 4
  IF FLAG(SAL2) > 1 MODIFY FLAG(SAL2) = 4

  IF FLAG(TEMP1) > 1 MODIFY FLAG (TEMP1)= 4
  IF FLAG(TEMP2) > 1 MODIFY FLAG (TEMP2)= 4
  If the doubt is on the pressure, flag all the parameters
  IF FLAG(PRES1) > 1
  MODIFY FLAG (PRES1)= 4, FLAG(TEMP1) = 4 , FLAG(SAL1) = 4
  IF FLAG(PRES2) > 1
  MODIFY FLAG (PRES2)= 4, FLAG(TEMP2) = 4 , FLAG(SAL2) = 4
- In case of instability, if no anomaly has been previously detected (all flags = 1 at levels PRES1 and PRES2) then arbitrarily modify the flag on the level 2 only to facilitate the visualization and the further manual correction of the flags:
  FLAG (PRES2)= 4, FLAG(TEMP2) = 4 , FLAG(SAL2) = 4

4.5.2.9. Test of the Redfield ratio for nutrients

This test is in preparation, only for visual checking (see 5.2)

4.5.2.10. Manual Check of the data and validation of the flagging

The coherence and continuity of the observations within a cruise is only checked subjectively, and allow making manual corrections of the flags especially:

- in coastal water where the control values are poorly estimated
- when there is a doubt on the climatological reference, or if these values are missing
- in the thermo cline where very strong gradients are assimilated with spiky values
- when the standard deviation is missing or poorly estimated (frequently, the value is two low)
- to validate the vertical stability check.

These checks are implemented by using the following displays for each parameter, including the density (which is not archived, but give additional information):

- Separate and superposed profiles of vertical variations; the reference profile of the current profile is plotted with the envelope of « good » values when this envelope can be computed;
- waterfall diagrams;
- superposed and waterfall temperature/salinity diagrams

The data points are plotted separately or joined by straight lines between two consecutive points, and coloured according to the computed flags. During these checks, it is always possible to check the location of the profile on the map, and the cruise identifier and name will be displayed permanently during the visual inspection

Superposing the profiles of another cruise of the same region checks external coherency of the data.

4.5.3. Global Quality check for the parameters and profile

Before going to the next profile, global quality test are assigned to each parameters. For each parameter, if at least 80% of the values are without outliers, the global parameter is flagged to 1 (good). If not, the global flag is assigned to the most frequent error flag.
For the global profile quality flag, the value is assigned to the minimum value of the global parameters flags (out of the reference parameter).

GLOBAL Q Flags	1 Correct	2 Inconsistent with statistics	3 doubtful, questionable	4 bad, wrong, erroneous	9 Missing value
PARAMETER	> 80% values without outliers	> 20% values with Q flag=>2	> 20% values with Q flag=>3	> 20% values with Q flag=>4	
PROFILE	Few Outliers	min of global parameters Quality Flag =2	min of global parameters Quality Flag =3	- no pressure recorded (nor depth) - constant profiles - min of global parameters Quality F =4	*not allowed*

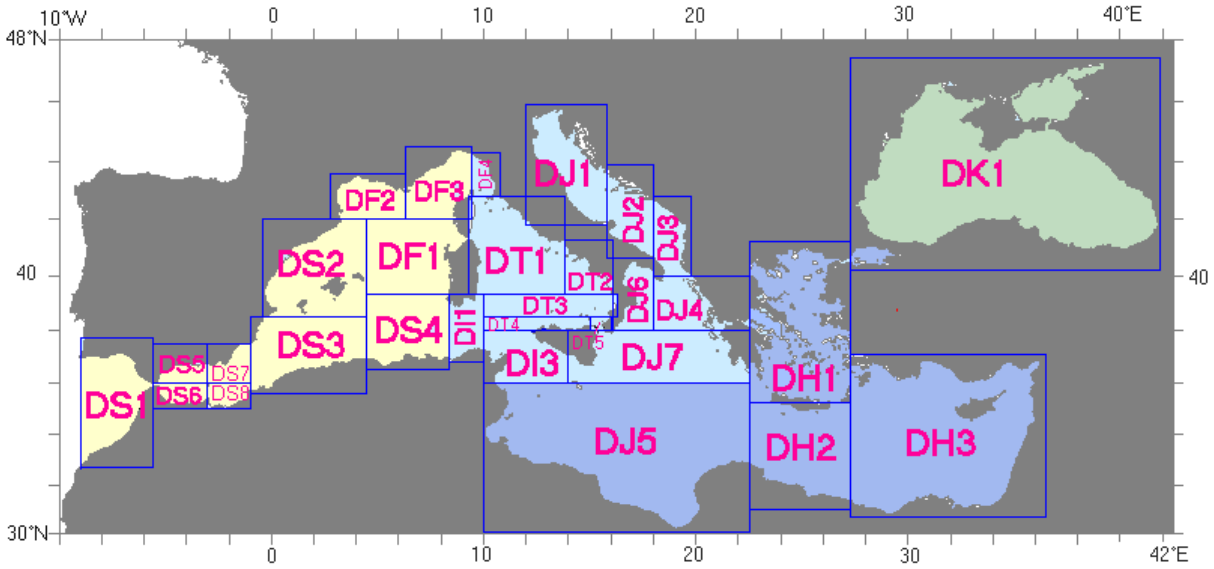
4.6. Regional Parameterisation

4.6.1. Limits of the sub-domains

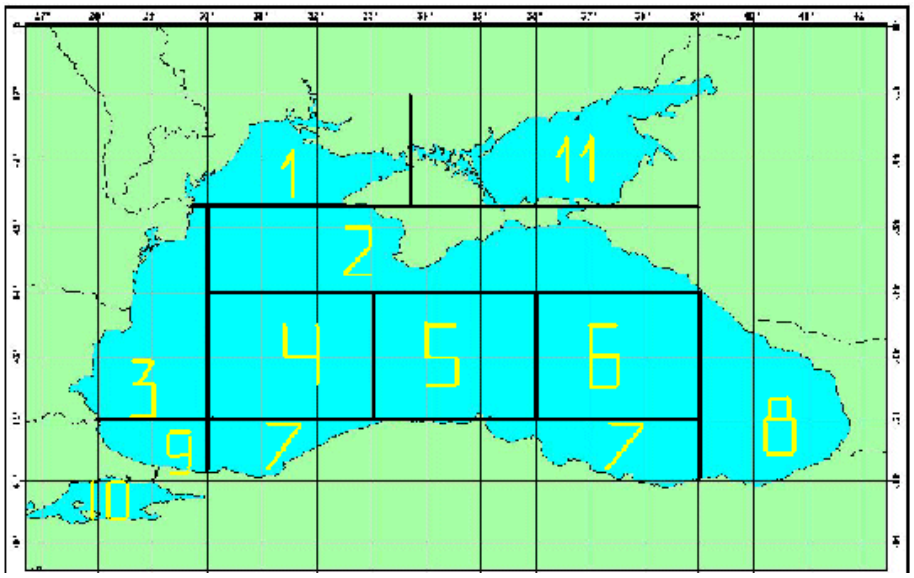
For simplicity, the region has been subdivided in rectangle geographical sub-domains, whose geographical limits and maximum depth value are given in the following table and available on WWW:

http://www.ifremer.fr/medar/htql/liste_region.htql

Mediterranean



Black Sea



CODE	NAME	LAT. MIN.	LAT. MAX	LON. MIN.	LON. MAX	MAX DEPTH.
DF1	ALGERIAN BASIN NORTH	N39 18.00	N42 00.00	E004 30.00	E009 18.00	2900
DF2	GULF OF LIONS	N42 00.00	N43 36.00	E002 48.00	E006 18.00	2732
DF3	LIGURIAN SEA WEST	N42 00.00	N44 30.00	E006 18.00	E009 24.00	2964
DF4	LIGURIAN SEA EAST	N42 48.00	N44 18.00	E009 24.00	E010 48.00	1632
DF5	BERRE POND	N43 20.00	N43 42.00	E004 57.00	E005 15.00	100
DH1	AEGEAN SEA	N35 15.00	N41 12.00	E022 30.00	E027 18.00	4500
DH2	CRETAN PASSAGE	N31 00.00	N35 15.00	E022 30.00	E027 18.00	4220
DH3	LEVANTINE BASIN	N30 42.00	N37 04.00	E027 18.00	E036 30.00	4620
DI1	SARDINIA STRAIT	N36 48.00	N39 18.00	E008 24.00	E010 00.00	2857
DI3	SICILIA STRAIT	N36 00.00	N38 00.00	E010 00.00	E014 00.00	1585
DJ1	ADRIATIC NORTH	N41 54.00	N45 54.00	E012 11.00	E015 07.00	250
DJ2	ADRIATIC MIDDLE	N40 36.00	N44 54.00	E015 07.00	E018 02.00	1362
DJ3	ADRIATIC SOUTH	N40 00.00	N42 48.00	E018 02.00	E019 54.00	1375
DJ4	IONIAN 1 (NE)	N38 00.00	N40 00.00	E018 00.00	E022 30.00	3725
DJ5	IONIAN 2 (SOUTH)	N30 06.00	N36 00.00	E010 00.00	E022 30.00	4465
DJ6	IONIAN 3 (NW)	N38 00.00	N40 36.00	E016 07.80	E018 00.00	2826
DJ7	IONIAN 4 (MIDDLE)	N36 00.00	N38 00.00	E014 00.00	E022 30.00	5121
DK0	BLACK SEA AND SEA OF ASOV	N40 12.00	N47 24.00	E027 18.00	E041 54.00	2313
DK1	BLACK SEA NORTH WEST SHELF	N45 20.00	N46 50.00	E029 30.00	E033 50.00	1000
DK2	BLACK SEA NORTH SLOPE	N44 00.00	N45 20.00	E030 00.00	E039 00.00	1500
DK3	BLACK SEA WEST SLOPE	N42 00.00	N45 20.00	E027 30.00	E030 00.00	1500
DK4	BLACK SEA WEST ABYSSAL	N42 00.00	N44 00.00	E030 00.00	E033 00.00	2313
DK5	BLACK SEA CENTRAL ABYSSAL	N42 00.00	N44 00.00	E033 00.00	E036 00.00	2313
DK6	BLACK SEA EAST ABYSSAL	N42 00.00	N44 00.00	E036 00.00	E039 00.00	2313
DK7	BLACK SEA SOUTH SLOPE	N40 55.00	N42 00.00	E030 00.00	E039 00.00	1500
DK8	BLACK SEA SOUTH-EAST SLOPE	N40 50.00	N44 10.00	E039 00.00	E041 40.00	1500
DK9	BLACK SEA ADJACENT TO BOSPHORUS	N41 05.00	N42 00.00	E028 00.00	E030 00.00	1500
DL0	MARMARA SEA	N40 12.00	N41 05.00	E026 50.00	E030 00.00	1000
DL1	SEA OF AZOV	N45 20.00	N47 20.00	E033 50.00	E039 20.00	200
DS1	GIBRALTAR STRAIT	N33 00.00	N37 42.00	W009 00.00	W005 36.00	3000
DS2	BALEARIC SEA	N38 30.00	N42 00.00	W000 24.00	E004 30.00	2700
DS3	ALGERIAN BASIN SW	N35 36.00	N38 30.00	W001 00.00	E004 30.00	2800
DS4	ALGERIAN BASIN SE	N36 30.00	N39 18.00	E004 30.00	E008 24.00	3000
DS5	ALBORAN NW	N36 00.00	N37 30.00	W005 36.00	W003 00.00	2000
DS6	ALBORAN SW	N35 00.00	N36 00.00	W005 36.00	W003 00.00	2000
DS7	ALBORAN NE	N36 00.00	N37 30.00	W003 00.00	W001 00.00	2700
DS8	ALBORAN SE	N35 00.00	N36 00.00	W003 00.00	W001 00.00	2800
DT1	TYRRHENIAN (NW) 1	N39 18.00	N42 48.00	E009 18.00	E013 48.00	3162
DT2	TYRRHENIAN (NE) 2	N39 18.00	N41 18.00	E013 48.00	E016 6.00	3128
DT3	TYRRHENIAN 3	N38 30.00	N39 18.00	E010 00.00	E016 18.00	3146
DT4	TYRRHENIAN 4	N38 00.00	N38 30.00	E010 00.00	E015 00.00	1513
DT5	TYRRHENIAN 5 (MESSINA)	N38 00.00	N38 30.00	E015 00.00	E016 00.00	1022

4.6.2. Broad Range Control Values for the parameters

All the archived parameters of 3.6 have default minimum and maximum, and if determined, adjusted minimum and maximum values in the sub-region defined in the previous table. The updated values can been accessed by clicking each parameter code on:

http://www.ifremer.fr/medar/htql/liste_param.htql

(*) DOX1, DOX2 will be converted in approximate DOXY to perform QC

NTAW, NTIW, PHOW, SLCW, SSAL to approximate NTRA, NTRI, PHOS, SLCA, PSAL

Total nitrogen and HYDROGEN SULPHIDE (H2S) have still no known statistical values.

(**) For Chlorophyll-a, if one measurement only, use CPLH code and use in addition CPH1 if 2 measurements of chlorophyll-a with different methods exist in the same data file.

Note: 3 codes have been currently used in the past with same unit 0.01mg/m3:

1) CPHL: chlorophyll-a with no more information;

2) chlorophyll-a SU: (SCOR UNESCO) with sometimes comments like "fluorescence and calibration"

3) *chlorophyll-a SA: with comment "active after acidification"*

They are not comparable and the QC will be limited.

Additional parameters can be recorded with the core parameters profiles, especially optical values with CTD. In general they do not need to be extracted, but will not be QC unless broad range statiscs are well established.

Only geophysical parameters should be archived, and not preliminary technical parameters, unless source scientists specific request

5. PROCESSINGS

Processing are necessary to :
- prepare the best manageable climatology
- prepare the Redfield ratio test for nutrients *(in preparation)*
- interpolate the data at standard levels before performing the analysis

5.1. Preparation of the averaged MEDATLAS Climatology

According to the QC workshop discussion (12), it was decided to adapt the MEDATLAS 97 climatology to make it usable for the quality checks. The result should be a 1x1 degree mean profiles of temperature and salinity and corresponding standard deviations.

5.1.1. Processing of the climatological temperature and salinity

The temperature and salinity 0.25 square degrees have been averaged in 1 degree square boxes.

5.1.2. Processing of the standard deviations

The maximum value of the 0.25 square degree standard deviation found in the 1 square degree box has been taken as the resulting standard deviation. However the results were not satisfactory because obviously too high or too low values were found in some sub-regions. It was therefore necessary to apply some QC on the standard deviations before the selection. As a result not all the means were associated to standard deviation estimates and interpolations/extrapolations have been made.

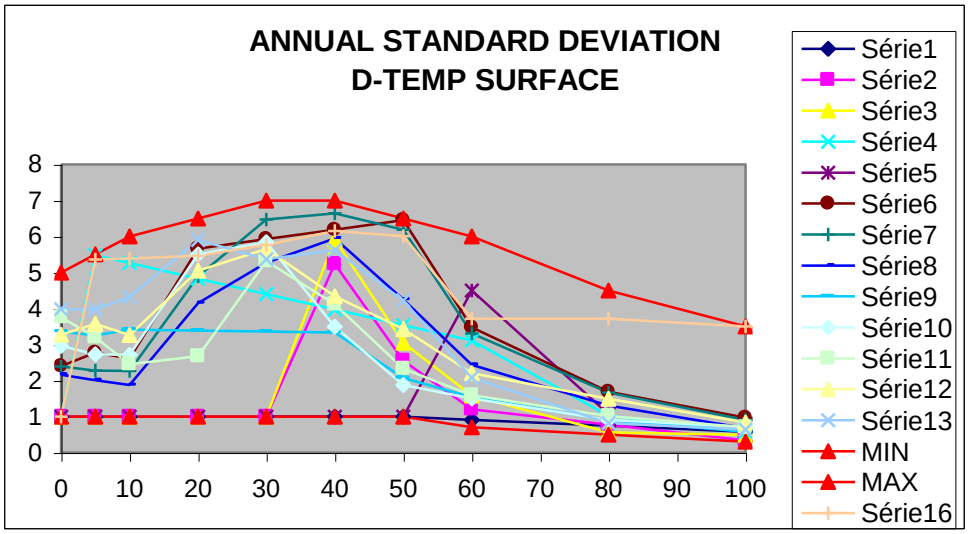
5.1.2.1. QC of the standard deviations

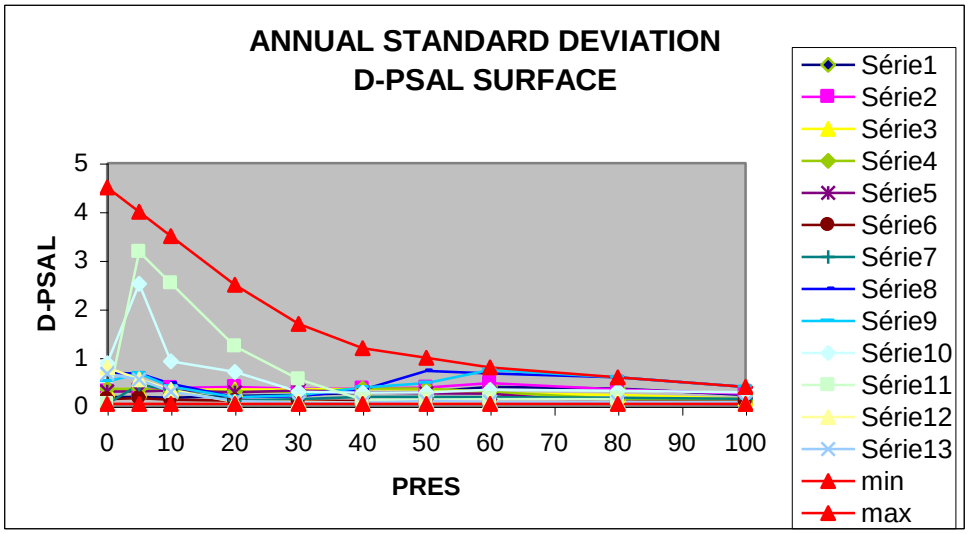
The values out of the following envelope of maximum and minimum values have been rejected before processing :

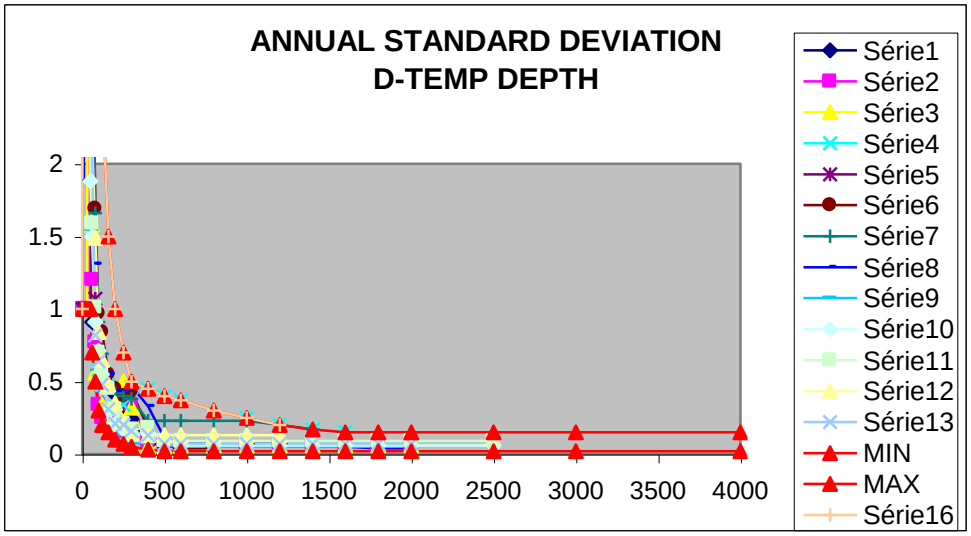
	min-stdev-T	max-stdev-T	min-stdev-S	max-stdev-S
0	1	5	0.05	4.5
5	1	5.5	0.05	4
10	1	6	0.05	3.5
20	1	6.5	0.05	2.5
30	1	7	0.05	1.7
40	1	7	0.05	1.2
50	1	6.5	0.05	1
60	0.7	6	0.05	0.8
80	0.5	4.5	0.05	0.6
100	0.3	3.5	0.05	0.4
120	0.2	2.5	0.04	0.3
160	0.15	1.5	0.03	0.25
200	0.1	1	0.02	0.22
250	0.07	0.7	0.02	0.21
300	0.05	0.5	0.02	0.2
400	0.03	0.45	0.02	0.2
500	0.02	0.4	0.02	0.2
600	0.02	0.37	0.02	0.2
800	0.02	0.3	0.02	0.2
1000	0.02	0.25	0.02	0.2
1200	0.02	0.2	0.02	0.2

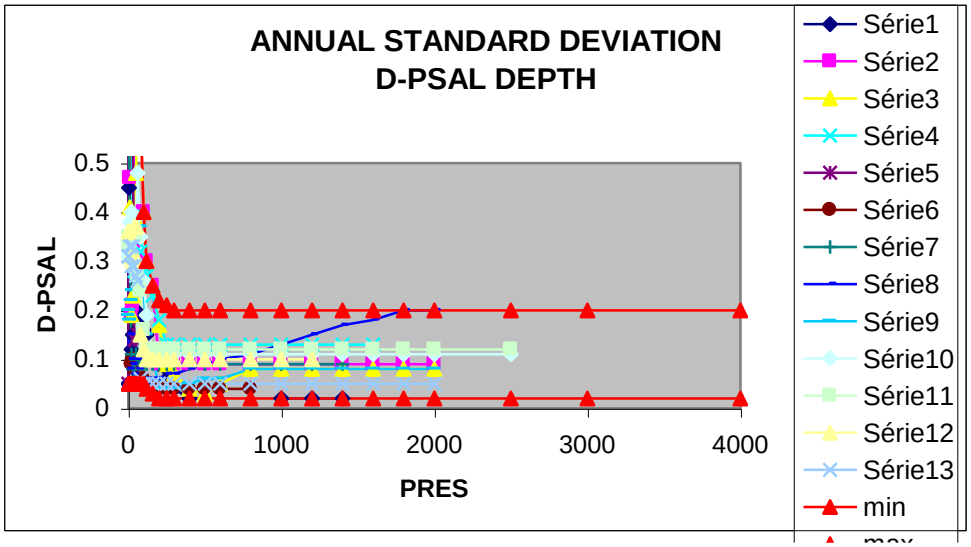
1400	0.02	0.17	0.02	0.2
1600	0.02	0.15	0.02	0.2
1800	0.02	0.15	0.02	0.2
2000	0.02	0.15	0.02	0.2
2500	0.02	0.15	0.02	0.2
3000	0.02	0.15	0.02	0.2
4000	0.02	0.15	0.02	0.2

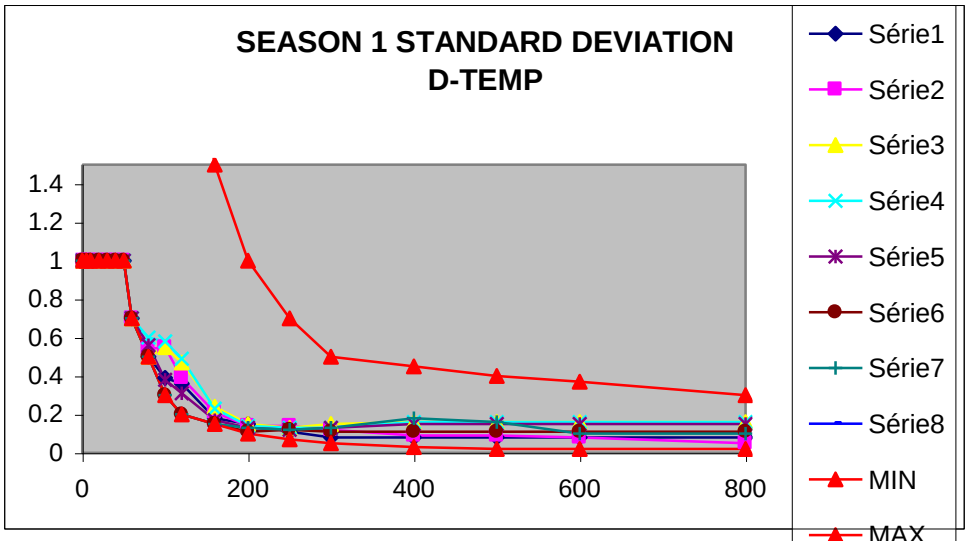
On the following figures, test of values for the annual standard deviations compared with min-max envelope, and the same for seaonal1 (winter, minimum of variability) and season 3 (summer, maximum of variability).

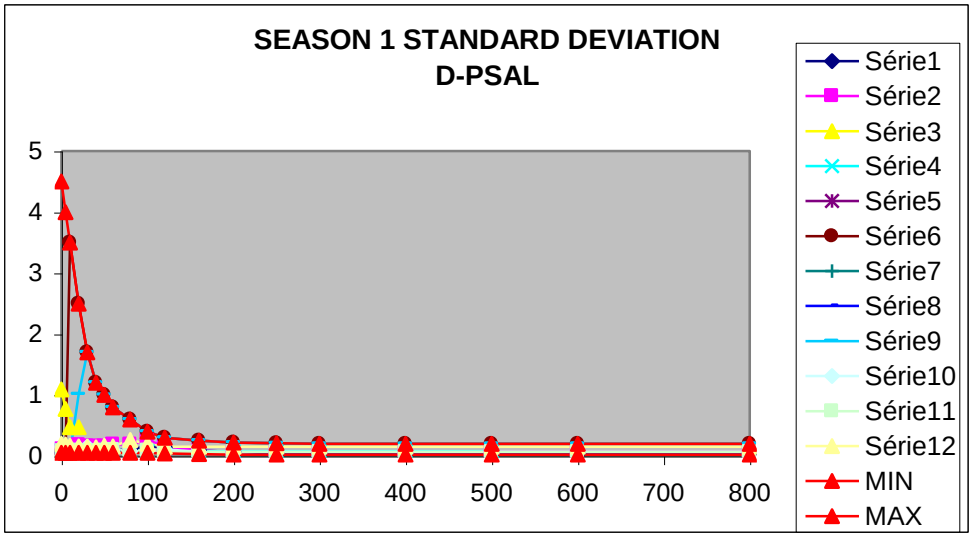


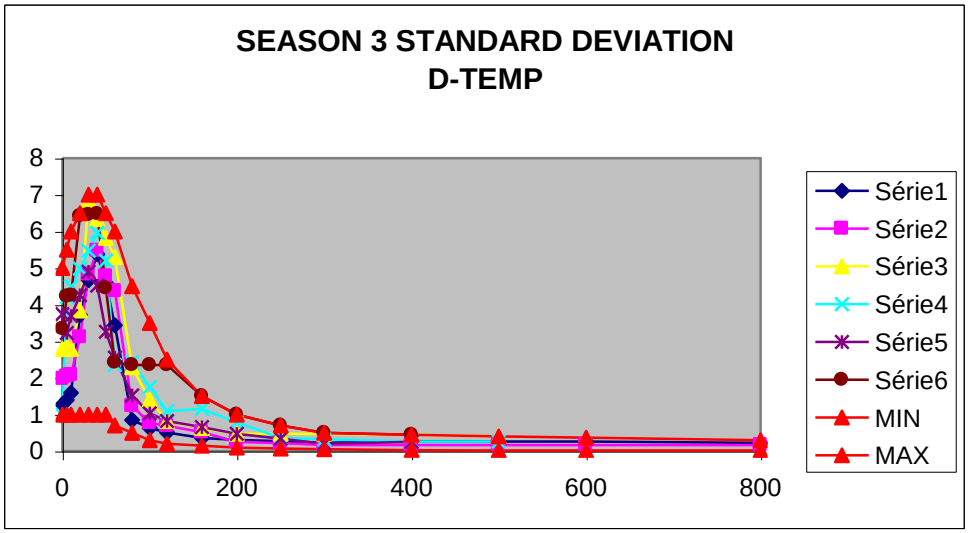


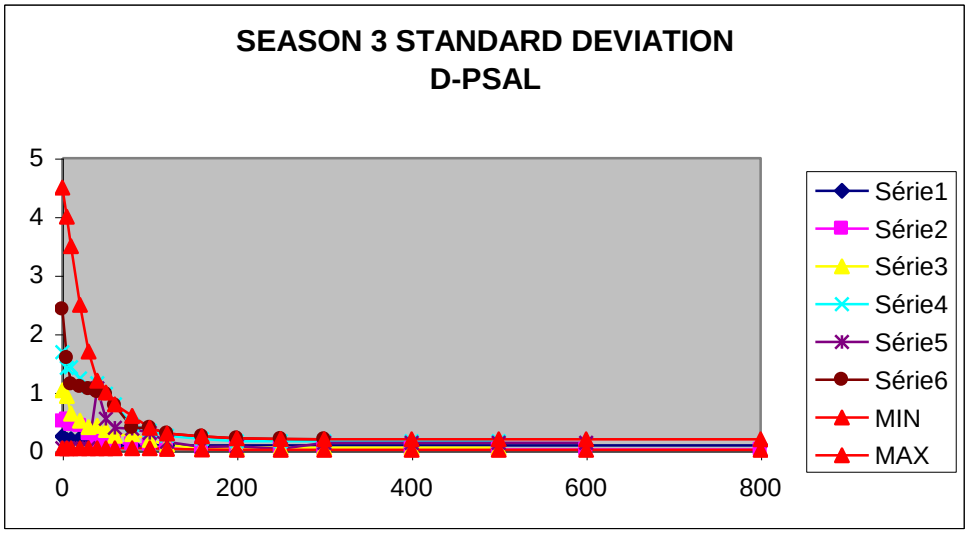

ANNUAL STANDARD DEVIATION
D-TEMP DEPTH
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
Série1
Série2
Série3
Série4
Série5
Série6
Série7
Série8
Série9
Série10
Série11
Série12
Série13
MIN
MAX
Série16


ANNUAL STANDARD DEVIATION
D-PSAL DEPTH
D-PSAL
0.5
0.4
0.3
0.2
0.1
0
0
1000
2000
3000
4000
PRES
Série1
Série2
Série3
Série4
Série5
Série6
Série7
Série8
Série9
Série10
Série11
Série12
Série13
min


SEASON 1 STANDARD DEVIATION
D-TEMP
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
Série1
Série2
Série3
Série4
Série5
Série6
Série7
Série8
MIN
MAX







5.1.2.2. Interpolation/Extrapolation

Then the maximum of the remaining values of the 1x1 degree square has been selected. As many level were it existed a mean value, still remain without estimated standard deviation, it has been taken:

- interpolated values were existed values above and below and the QC test was performed on the interpolated values. If an interpolated value was > max, then the interpolated value was replaced by the max value and if an interpolated value was < min, then the interpolated value was replaced by the min value
- last value when existed values only values above below and the QC test was performed on the extrapolated values
- first non default value for the extrapolation at the surface.

For all the extrapolated values, the minimum value of the QC envelope was taken, if the QC test did not succeed.

5.1.3. Access to the resulting climatology

The averaged climatology can be accessed from the web site (www.ifremer.fr/medar/quality.htm)
The 4 files (annual, seasonal) are organised by vertical profiles in auto descriptive ASCII

Example:

```
Mediterranean seasonal MEDATLAS climatology (release 1) per 1
degree square (0-800m)
Parameter: Temperature (Celsius.Degrees)
Parameter: Salinity (P.S.U.)
Period: Winter (months:01,02,03)
Latitude: +31.500000    Longitude: +32.500000
Mean value   Standard deviation per parameter and immersion;
IMMER;       TEMPERATURE;;          SALINITY;;
    0;      17.41;    2.00;      38.94;    0.13;
    5;      17.37;    2.00;      38.92;    0.10;
   10;      17.32;    2.00;      38.91;    0.10;
   20;      17.30;    2.00;      38.96;    0.08;
   30;      17.25;    2.00;      38.96;    0.07;
   40;      17.20;    2.00;      38.97;    0.08;
   50;      17.37;    2.00;      39.02;    0.08;
   60;      17.27;    1.00;      38.94;    0.08;
   80;      17.07;    0.90;      38.92;    0.08;
  100;      16.90;    0.84;      38.94;    0.08;
  120;      16.75;    0.76;      38.94;    0.08;
  160;      16.29;    0.56;      38.98;    0.08;
  200;      15.86;    0.41;      38.99;    0.08;
  250;      15.40;    0.38;      38.98;    0.08;
  300;      14.94;    0.31;      38.96;    0.08;
  400;      14.23;    0.17;      38.92;    0.08;
  500;      13.91;    0.04;      38.87;    0.08;
  600;      99.99;   99.99;      99.99;   99.99;
  800;      99.99;   99.99;      99.99;   99.99;
```

5.2. Test of the Redfield Ratio

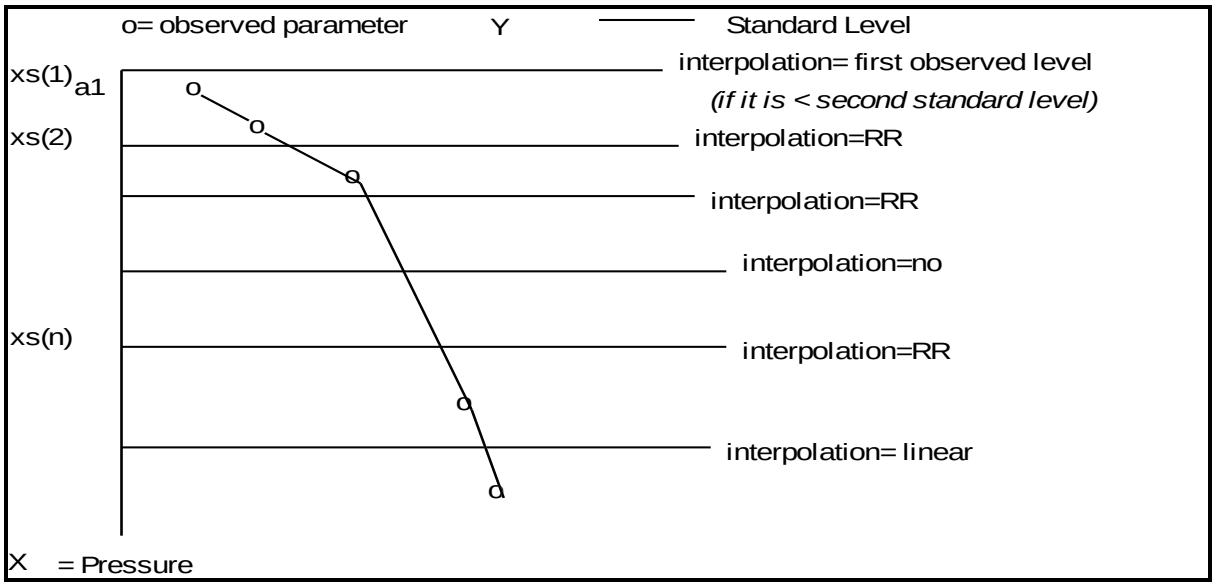
An additional test is the Redfield ratio : the ratio of the oxygen, nitrate and alkalinity (carbonates) concentration over the phosphate concentration has been estimated respectively to 172, 16 and 122 by Takahashi & al. (13) in the Atlantic and Indian Ocean. New studies are made in the frame of MEDAR and CYCLOPS and these values will be adjusted for the Mediterranean in a near future.
These estimate allow a visual check on the corresponding nutrients, by checking the dispersion around the reference curve.

5.3. Standard level Interpolation

Vertical interpolation of the observed parameters at the standard levels where the climatological statistics will be computed. In order to get a smoother vertical curve and consequently more realistic than a simple linear interpolation, that is a more realistic vertical curve, the later is corrected.
Before the interpolation, only the data points with no outlier at all (Q flag=1) are extracted.

5.3.1. Method and algorithms

The Reiniger & Ross (1968, here below referred as RR (11)) weighted parabolic interpolation is recommended by IOC and ICES and is widely used in the scientific community, in particular by Levitus at the WDC-A. The value of the correction made on the linear interpolation is a function of the difference between the linearly interpolated value and the two values extrapolated from the above and below levels.
The computation requires a profile of at least 4 levels. The authors extend the method for only 3 data points for the top and bottom of the profile, but the method is then not safe. In this case, we systematically replace by a linear interpolation.
In the case of no observed values between the standard level and the consecutive levels below and above, no interpolation is made.



The RR linear reference function and the weights of the parabolic function depend on variable exponents. We take the same exponent values as RR, but in these values may be adjusted later.
All the interpolated parameters are initialised with the default value at the standard levels.

5.3.2. Choice of the Mediterranean standard levels

For MEDATLAS 1997, the following 28 vertical levels have been processed:
0, 5, 10, 20, 30, 40, 50, 60, 80, 100, 120, 160, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2500, 3000, et 4000 m

5.3.3. RR parabolic interpolation

The interpolated value of y (temperature or salinity) is a weighted means of the two parabolic interpolations that use respectively the 3 superior data points and the 3 inferior data points.
The weights are a function of the difference between the parabolic interpolation and a reference function. This reference function is a combination of the linear interpolation and extrapolations using the 4 data points.
When none of the interpolating conditions are found, the parameter keeps the default values.
No control is made on the flags, only on the default values.

5.3.3.1. Conditions for computation

x=xs(n) y=ys(n)
a(1) < a(2) < x < a(3) < a(4)

First a check is made that the layers above and below are not both empty:

if a(2) < x(n-1) and a(3) > x(n+1) then ys(n) = default value

5.3.3.2. Algorithm:

```
      dimension a(4),b(4)

the adjustable exponents are given the values used by RR
        rm=2.
        rn=1.

compute the parabolic interpolations
     y1=fparb(x,a(1),a(2),a(3),b(1),b(2),b(3))
     y2=fparb(x,a(2),a(3),a(4),b(2),b(3),b(4))

compute the reference function
    yr=fref(x,a,b,rm)

compute the differences
   d1=abs(yr-y1)**rn
   d2=abs(yr-y2)**rn

compute the weights
    r1=d1/(d1+d2)
    r2=d2/(d1+d2)

compute the weihted mean
    y=r1*y2+r2*y1
```

5.3.3.3. linear interpolation

```
    function flin(x, a,b)

      dimension a(2),b(2)
     flin=b(1) + (x-a(1))*(b(2)-b(1))/(a(2)-a(1))
```

5.3.3.4. reference linear function

```
      function fref(x,a,b,rm)
          dimension a(4),b(4)
           real x,a,b

  if  a(1) < a(2) < x < a(3) < a(4)    and rm> 1. (else error)
   then
           y12=flin(x,a(1),a(2),b(1),b(2))
           y23=flin(x,a(2),a(3),b(2),b(3))
           y34=flin(x,a(3),a(4),b(3),b(4))

            d123=(y12-y23)**rm
            d234=(y23-y34)**rm

           fref=0.5*(y23+(d234*y12 + d123*y34)/(d234+d123))
```

5.3.3.5. parabolic interpolation between 3 points

```
          function fparab(x,a,b)

          dimension a(3),b(3)
           dimension gamma(3)

           gamma(1)=(x-a(2))*(x-a(3)) / ((a(1)-a(2))*(a(1)-a(3)))
           gamma(2)=(x-a(3))*(x-a(1)) / ((a(2)-a(3))*(a(2)-a(1)))
           gamma(3)=(x-a(1))*(x-a(2)) / ((a(3)-a(1))*(a(3)-a(2)))

           yp=gamma(1)*b(1)+gamma(2)*b(2)+gamma(3)*b(3)
           fparab=yp
```

5.3.4. Top and bottom of the profile

5.3.4.1. First standard level xs(1)

ys(1) = fist observed parameter if the first observed level a(1) < xs(2)
else ys(1)=default value

5.3.4.2. Next standard levels when there is only one observed level above

If it exists at least one point below, then the standard level is computed by using a linear interpolation:

ys=flin(xs,a(1),a(2),b(1),b(2)) and flag=5 unless the standard level is an observed level

a(1), b(1) being the observed data point above the standard level and (a(2), b(2)) the observed data point below.

5.3.4.3. Last standard level at the bottom of the profile

When there is only one point below, the same linear interpolation is made.

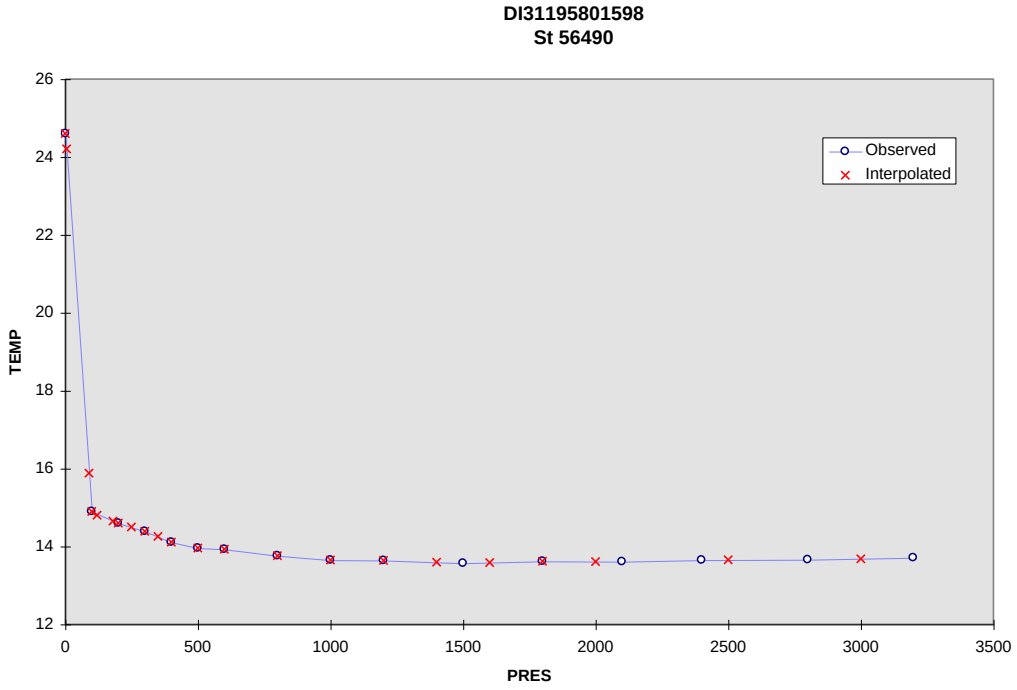
5.3.5. Tests and Results

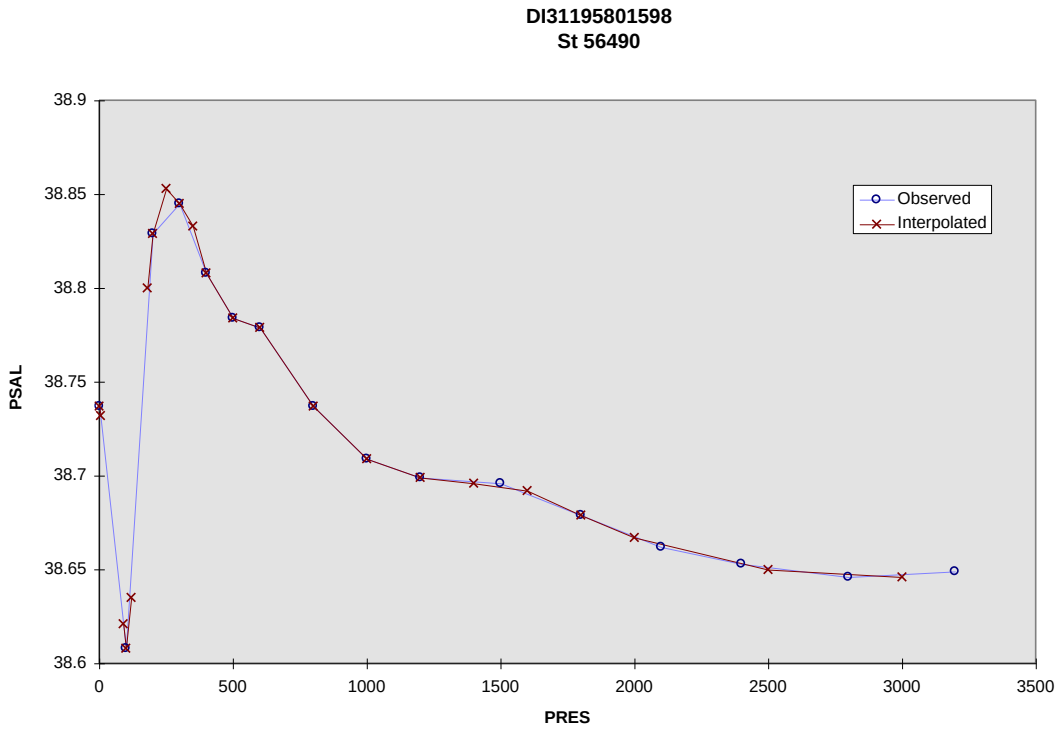
The software has been tested for the following:

- **Input/output**
  - no change in the number of stations within the files
  - output format
  - not change in the location and date
- **Criteria for the computation**
  - top and bottom of the profiles
  - stations with low number of data points
  - empty intermediate levels
- **Control of the interpolated values**

The computed interpolated values have been controlled at SISMER and a bench mark set of data sent to ICES who kindly gave assistance to detect the errors.

As an example, the processing of a station from the ATLANTIS 1958 in the deep Ionian Sea is plotted here below.


DI31195801598
St 56490
TEMP
PRES
Observed
Interpolated
26
24
22
20
18
16
14
12
0
500
1000
1500
2000
2500
3000
3500


DI31195801598
St 56490
PSAL
PRES
Observed
Interpolated
38.9
38.85
38.8
38.75
38.7
38.65
38.6
0
500
1000
1500
2000
2500
3000
3500

6. REFERENCES

(1) Intergovernmental Oceanographic Commission of UNESCO, 1998. MEDAR/MEDATLAS Meeting, Istanbul, Turkey, 21-23 May 1997 Summary Report, IOC/INF-1084.

(2) CEC/DG XII, MAST and IOC/IODE, 1993. Manual of Quality Control Procedures for validation of Oceanographic Data. UNESCO Manual and Guides N° 26, 436 P.

(3) Formatting Guidelines for Oceanographic Data Exchange. IOC/IODE/GETADE Report. IOC/ICES, Report.
http://www.ices.dk/ocean/formats/getade.htm

(4) NOAA/NGDC, 1993. ETOPO5. 5-minute gridded elevation/bathymetry for the world. Global Relief Data. CDROM.

(5) JONES M.T., BODC, 1994. General Bathymetric chart of the Ocean, the GEBCO digital Atlas, CDROM.

(6) MEDATLAS Group. MEDATLAS 1997 Database and climatological atlas of temperature and salinity. 3 Cdroms, IFREMER Ed.

(7) BRASSEUR P., SCHOENAUEN R.. Seasonal Data Fields for the Mediterranean sea. University of Liege, GHER internal Report.

(8)LEVITUS S., Climatological Atlas of the World Ocean , 1994 Edition

(9) MILLERO F.J. and POISSON A., 1981. International one-atmosphere equation of state of seawater. Deep-sea ressearch, Vol.28A, No. 6, pp 625-629.

(10) FOFONOFF N.P. and MILLARD R.C., 1983. Algorithms for computation of fundamental properties of seawater Unescop technical papers in marine science 44, 53 p.

(11)REINIGER R.F. and ROSS C.K., 1968. A method of interpolation with application to oceanographic data. Deep-Sea Research, Vol 15, pp 185-193.

(12) MEDAR Group, 2000. MEDAR Data Quality Control Workshop Report. Rap. Int. IFREMER/TMSI/IDM/SISMER/SIS00.056

(13) Takahashi T., W.S. Broecker and S. Langer, 1985. Redfield Raatio Based on Chemical Data from Isopycnal Surfaces. J. Geophys. Res., Vol 90, N°C4, 6907-6924.