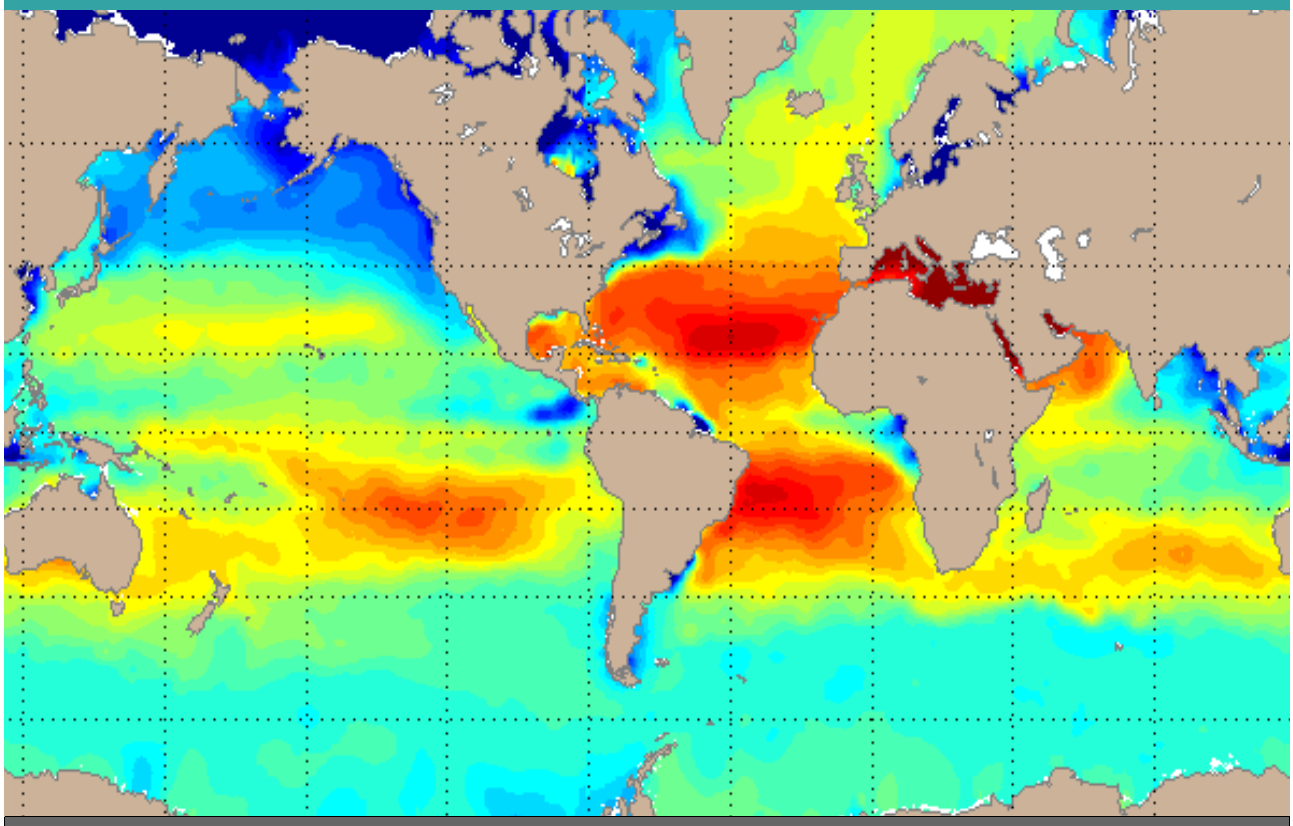

ISAS-Tool Version 6: User's manual

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History

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1. INTRODUCTION

ISAS (In Situ Analysis System) is an analysis tool for producing gridded scalar fields. At the moment it is set to process temperature and salinity. Originally designed for the synthesis of ARGO dataset, it has been tested for the first time on the POMME area in the North-East Atlantic in 2000, it was later extended to the Atlantic and the Global ocean as the Argo array was setting up. It is developed and maintained at LPO (Laboratoire de Physique des Océans) within the **Argo** Observing Service (SO-ARGO) where it is used for research purposes on ocean variability. ISAS is made available to the **Coriolis** datacenter for exploitation in operational mode. The analysis is performed on the datasets prepared by Coriolis according to Argo recommendations for data quality control and NetCDF format. A set of background and statistical information required to complement the observations are provided with the software, as part of the configuration. For each analysis date, the results are provided in two NetCDF files, one holding the data and analysis residuals, the other holding the gridded fields and estimation error, expressed as percentage of a priori variance.

This document describes how to implement the ISAS software. The main steps of the process are detailed and examples of configuration files are provided. The statistical method used to produce the estimate and the specific choices performed to implement the method are described in the **Method and Configuration** document corresponding to the appropriate ISAS version.

2. General presentation

Producing a gridded field with a large dataset downloaded from a datacenter as Coriolis requires several preliminary operations before being able to perform the analysis. Two main tasks have been identified:

1. Definition of the configuration files that include : bathymetry, area limits and masks, as well as climatology (mean state and associated variance). They are provided in the defined. **confstd** directory.
2. Preprocessing of the data files to perform elementary checks and interpolates the data on standard levels. This is performed by the **STD** function.

The analysis (optimal interpolation) itself is divided in 3 elementary operations:

- **PREOA**: preparation of files and assembly of the datasets needed by the analysis.
- **OA**: Optimal interpolation (or analysis)
- **POSTOA**: assembly of the final files

The various files and programs are organized as indicated in.Figure 1 Note that STD, PREOA and POSTOA are writen in matlab while OA is in fortran 90.The directories and Configuration files

2.1. The software directories

These directories contains all programs and files required to perform the analysis. It is organized as follows.

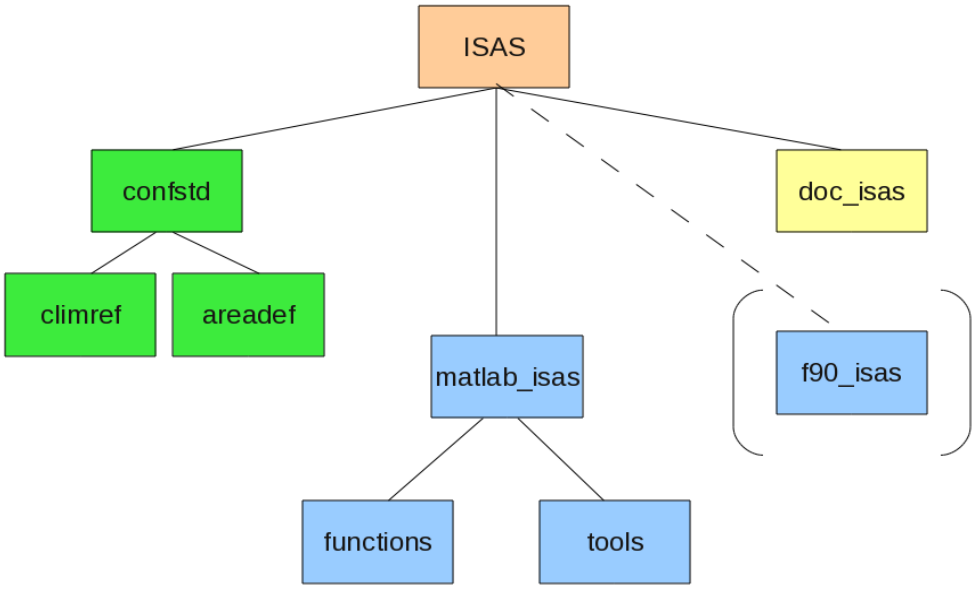

Figure 1: Program directories scheme

2.1.1. Configuration directory (confstd)

Provided by ISAS

The configuration proposed with ISAS-V6 is described in detail in (Gaillard et al, 2011). The horizontal grid is ½ degree Mercator limited to 80S-90N. The vertical levels are given in the Table 1.

Standard levels	[0 3]
	[5:5:100]
	[110:10:800]
	[820:20:2000]

Table 1: vertical standard levels

The directory « confstd » contains all files defining the standard configuration and statistics used by the analysis (Gaillard, 2011).

It is organised as follow in the directory:

- climref :
  - Bathymetry
  - Climatology (annual and monthly), for the parameter PSAL and TEMP
  - A priori variances (annual), for the parameter PSAL and TEMP
  - Covariance scales (annual, deduced from rossby radius calculated from the climatology)
- areadef:
  - Definition for analysis areas and masks.

2.1.2. Documentation directory (doc)

Provided by ISAS

This directory contains

- the programs documentation (pdf files)
- models of configuration files for matlab scripts and perl script that allow to loop over different analysis dates and parameters.
- models of batch and config files for the fortran part.all files defining the standard configuration and statistics used by the analysis (Gaillard, 2011):

2.1.3. Matlab scripts (matlab_isas)

Provided by ISAS

Contains the matlab scripts for version nn used for the data pre-processing and the analysis pre- and post-processing.

2.1.4. Fortran programs (f90_isas)

Provided by ISAS

This directory contains the source codes. A makefile and executable for SGI-Altrix is provided. Although isas_f90 is part of ISAS chain, it has to be copied in the fortran computer tree structure (see 4.2.1).

2.2. The data directories

2.2.1. The datasets

We briefly describe here the characteristics of the data types taken into account at the moment. These dataset have different accuracy, resolution and sampling that depend mostly on the sensor and on the storage and transmission system used.

Temperature and salinity measurements are obtained from autonomous instruments, drifting or anchored or from instruments deployed with a ship. The data are transmitted in real time by satellite, or in delayed mode. The main characteristics of the most common instruments are given below.

- **Profiling floats**: The autonomous floats are part of the ARGO program, they collect vertical profiles of temperature and salinity as a function of pressure between their maximum pressure (usually 2000 dbars) and the surface. At the end of the profile that takes nearly 5 hours, the profiler transmits the data to a satellite and dives toward its parking depth (1000 dbars), waiting for the next cycle (10 days later). Nominal accuracy of the data is assumed to be 0.01°C and 0.01 PSU. At present time a vertical profile is described by approximately 100 pts.
- **XBT**: An eXpendable BathyThermograph is launched from a steaming ship. It measures temperature (and salinity in the case of XCTD). The measurement depth is deduced from the XBT fall rate. The accuracy is 0.1°C and most XBT reach 800 m.
- **CTD**: This high quality measurement is obtained from a research vessel in the context of a scientific cruise. Pressure and temperature sensors are carefully calibrated and water samples are taken to adjust the salinity measurement. Standard procedure were defined for the WOCE experiment, they lead to accuracies of 0.001°C and 0.001 PSU.
- **Time series**: Time series of pressure, temperature and salinity are recorded at high time resolution (hours) from sensors installed on fixed points (mooring) or drifting buoys. The sensors are similar to those used on the profiling floats. The thermosalinographs, installed aboard scientific or commercial ships, are another type of time series data. The sensors are different from profiling floats ones. Depth measurement is usually constant.

2.2.2. The directories

Two directories are defined, as shown in Fig. 2:

- '**dir_raw/**' contains all raw data downloaded from the Coriolis datacenter. There must be one subdirectory per year : the user have to create dir_raw and the subdirectory by year. The naming convention of the raw files must follow Coriolis recommendations: datasetname_yyyymmdd_PR_XX.nc.

  Provided by User

  where yyyymmdd is the date of the measurments, and XX the type of data (PR for Profilers, CTD, ...)

- '**dir_std/**' this directory must be created before running the analysis. It will hold the data interpolated on the analysis levels. The subdirectory by year are created automatically by ISAS.

  Provided by User

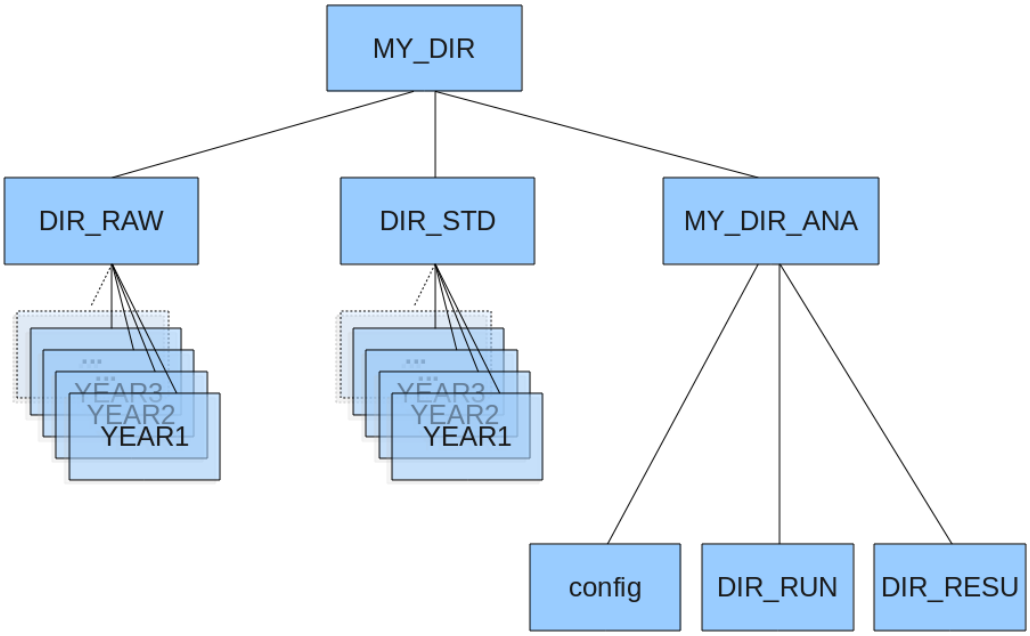

Figure 2: Data directories scheme

2.3. The analysis directory

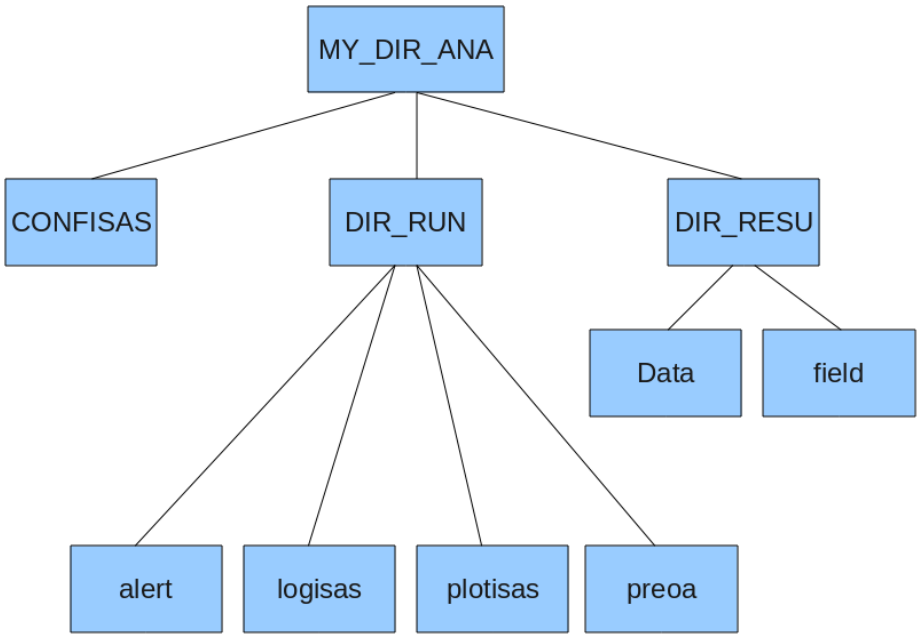

Figure 3: Analysis directories scheme

It contains 3 subdirectories, as shown in the figure 3.

- ‘dir_confisas/’
- ‘DIR_RESU/’
- ‘DIR_RUN/’

Created by User

2.3.1. Confisas directory

This directory must be created by the user. The model files found in isas/doc/config_matlab should be copied here and adapted to the user needs and configuration.

- isas_matlab.env: defines the matlab path
- config_isas_ana.txt: holds the data paths and the parameters that define the configuration. This file is read by isas_mat.

Before starting the analysis, the matlab paths need to be defined. The environment is described in a file isas_matlab.env that we recommend be placed in the directory confisas/. See isas_v6/doc/config_matlab for an example.

To launch, type:

```
cd confisas
source isas_matlab.env
```

Hereafter, an example of the isas_matlab.env file:

```
#!/usr/bin/sh
setenv MATHOME    /net/triagoz/export/home1/matlab/matlab_last
setenv TOOLBOXPATH
/net/triagoz/export/home1/matlab/outils_matlab/m_map1.4
setenv MATLAB ${MATHOME}
set path=($MATLAB $path)

#          Configuration ISAS          #
setenv ISAS_ANA_HOME  /home1/toto/lulu/prog_ISAS/svn/trunk/matlab_isas
setenv ISAS_ANA_PATH ${ISAS_ANA_HOME}/functions:${ISAS_ANA_HOME}/tools
echo  "  Toolbox  ISAS-ANA svn OK  "

setenv MATLABPATH ${ISAS_ANA_PATH}:${TOOLBOXPATH}
```

Furthermore, the various paths of the analysis, the file names and the different parameters must be defined. This is done through the configuration file: config_isas_ana.txt, that we recommend be placed in the directory: confisas/.

An example of configuration file is given in isas_v6/doc/config_matlab, and is reported in the annexe (8.1).

2.3.2. Results Directory (DIR_RESU)

Created by ISAS

This directory contains the analysis results in two subdirectories:

- **field**: contains the 3D field and error on the regular grid
- **data**: contains the data used by the analysis and the residuals.

2.3.3. Directory of calculation (DIR_RUN)

Created by ISAS

This directory contains the analysis run information in subdirectories:

- **preoa**: contains the pre-processed fields ready to be read in the analysis step.
- **logisas**: contains the log files
- **plotisas**: contains the plots created during the runs
- **alert**: contains the alert lists of suspicious profiles detected during the standardisation step STD.

3. Data Pre-processing

3.1. Description

The first step in the analysis is an interpolation of the raw data on the standard levels of the analysis grid. It is partly independent of the analysis, in the sense that the dataset produced can be used for different analysis. A new QC is introduced, it represents the quality of the interpolation (the closest to a measured value the lowest the QC flag value).

To avoid spoiling the analysis with eroneous data, a control is performed before the interpolation. Finally, oversampled points such as repeated fixed points CTD, drifting buoys, mooring, can be averaged (reduced) into super-profiles. The processing is detailled below.

3.1.1. Detection of erroneous data

Two different tests are succesively applied:

Distance to climatology:

A data point will be accepted if the value X verifies $|Xobs - Xclim| < \alpha_1 STD + \alpha_2 \frac{\delta X}{\delta z}$ where :

- The scalar α_1 (crit_std in the configuration file) has been determined empirically, it defines the distance allowed to the climatology.
- The scalar α_2 introduces an additional tolerance relative to the climatology. In the vicinity of very strong stratification, perfectly good data may differ strongly from the climatology. This is taken into account by introducing an additional tolerance proportional to the vertical gradient of the parameter.

Spike detection:

A data value is considered as a spike if the following conditions are filled:

- Change of sign of the first derivative for at least one point before or after the point.

- Second derivative criteria normalized by the median in the vicinity of the point:

$$\left|\frac{\delta^2 P}{\delta^2 z}(z)\right| \left(median\left(\left|\frac{\delta^2 P}{\delta^2 z}\right|\right)\right)^{-1} \geq crit\_spike$$

3.1.2. Interpolation

The high resolution data are bin averaged on the standard levels, then the remaining levels are interpolated. A new Quality Code (QC) is set to the data, related to the interpolation quality. The more the initial data is close to the interpolated one, the better the QC is. To eliminate interpolated pointd which sem too far from the measurement levels, one can select the str_qcmax_ana level (see PREOA part in the configuration file).

3.1.3. Reduction (superobs)

Data from the same platform which are close in time and space are averaged. The control parameters, defined in the configuration file, are:

RED_DXMAX: Minimum distance in kilometers
RED_DTMAX: Minimum time difference in days
RED_QCMAX: maximum QC-flag (after standardization)

3.2. Running STD

After setting the parameters of the STD block in the configuration file, STD_main can be launched in the matlab execution window.

STD files may remain on a daily sampling or data within a month can be grouped.

The climatological tests can be applied at two levels. The recommended procedure is:

1. perform a first pass with rather strict parameters:

crit_std_clim_1=6	*(distance allowed to climatology)*
alpha_clim_1=2	*(tolerance to take into account strong stratification)*
crit_spike_1 = 100,100	*(criteria for spike detection. Example for an anlaysis of temperature and Salinity).*

2. check the alert plots and flag with QC 4 or 8 the data considered wrong
3. perform a second pass with high values of the criteria (example in the configuration file)

Data rejected by the tests are not used to produce the STD files, but the corresponding value might be interpolated from the neighboring valid points. When all data from a profile are rejected the profile no longer appears in STD.

Examples for running STD:

Define the configuration file: config_fname = ’my_DIR_ANA/confisas/config_isas_ana.txt/’;

Then, launch STD_main (config_fname, [dd mm yyyy], nb_days, ipass, plot_display) with the set of input argument as follow:

- to process 10 days starting on july 14, 2011, first pass:

  dd = 14;
  mm = 07;
  yyyy = 2011;
  nb_days = 10;
  ipass = 1;
  plot_display = 1;

- to process a full month (ex july 2006):

  dd = 0;
  mm = 07;
  yyyy = 2011;
  nb_days = 0; % or anything, this value is ignored

An example of perl script to run STD_main over several month and years is given in the doc directory.

3.3. Outputs

3.3.1. Data files on standard levels

Results are writen as NetCDF files in the directory: DIR_RESU/std/. The naming convention is as follows:

ST_CCCCCCCC_YYYYMMDD_PR_TT.nc

ST	identifies « STD » data
CCCCCCCC	the dataset name
YYYYMMDD	the date of observation, if day = 00, file contains the whole month
PR	identifies « profile » data
TT	the data types according to Coriolis convention

3.3.2. Listing (log file)

The log files can be found in DIR_RUN /logisas/. For an analysis standardization step, there is two log files which names start with:

- std_mess: the detailled logfile
- std_summary: the summary log file

The suffix of each file name is composed of the date of the std data followed by the date of the run.

For example, the detailled logfile for a standardisation of july 2011, running in august 2011, the 12th, will be : std_mess_20110714_20110812.asc

Two examples of both log files are given in the Annexes (8.2.1, 8.2.2).

3.3.3. Control plots

Different types of plots can be found in DIR_RUN/plotisas/std.

Standard plot level (PLOT_CONV=1):

The nomenclature is:

ST_myanalysis_yyyymmdd_PR_XX.png

with yyyymmdd: the standardisation date, XX: the data type (PR for Profiler, CTD, ...)

A plot showing all profiles is produced, for both Temperature and Salinity (if it is the parameter aanlyzed), as shown in figure 4.

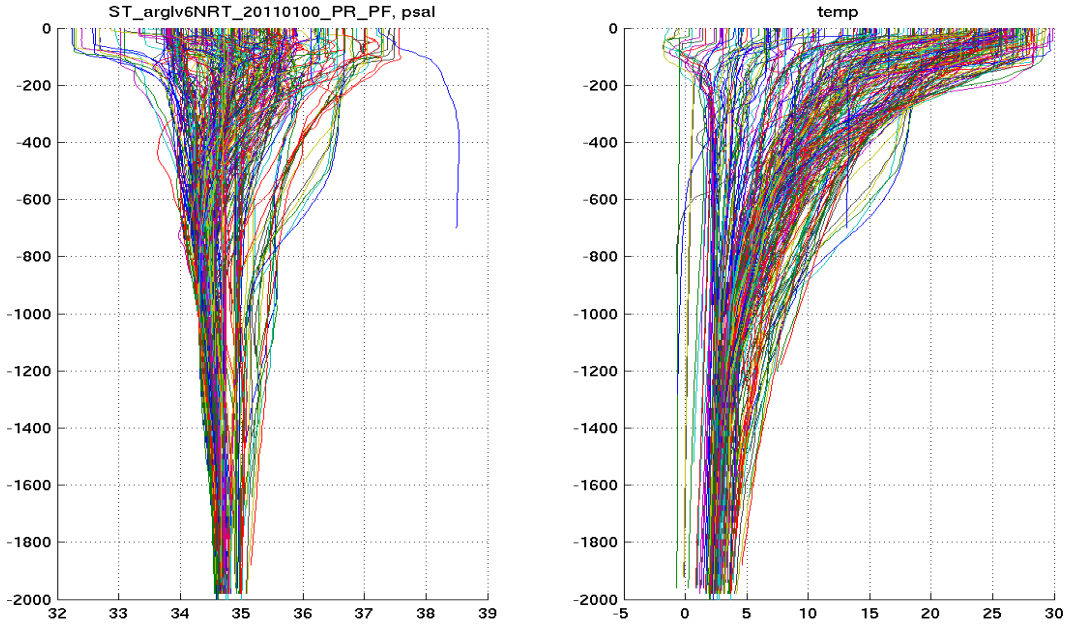

Figure 1: Example of standard plot level

High level plot (PLOT_CONV>1):

The plot shown in figure 5 shows, for each analysed parameter (most of the time Salinity and Temperature), the data standardized (red) and the raw data (blue).

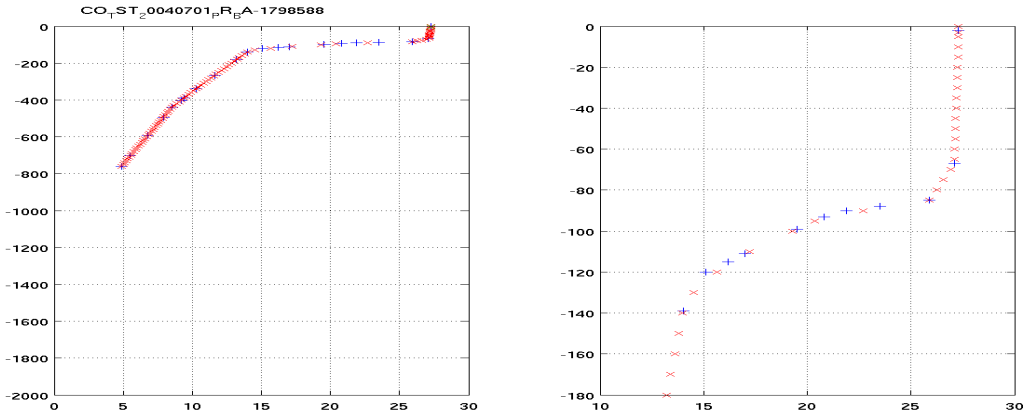

Figure 5: example of high level plot. The red cross are the data standardised, the blue one

represents the raw data.

Alerts

When data points are excluded, a plot is created in the directory alert/std (Figure 6). The profile reference is added to the list in the directory alert/list.

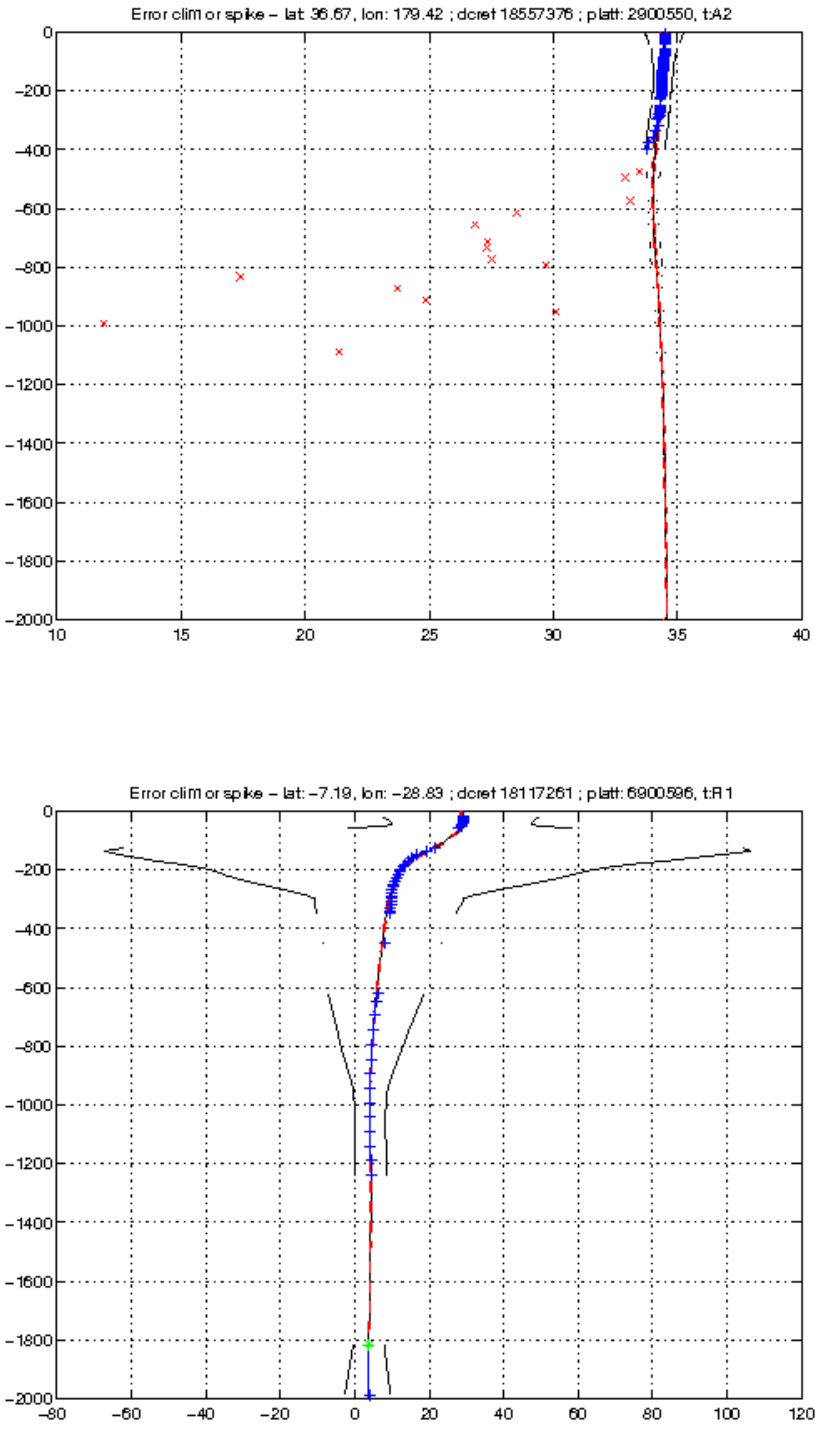

Figure 6: example of alert plots. Temperature and salinity data points in blue, climatology in black, corrected standard deviation criteria as dashed line. In red, the points excluded by the climatology test and in green the points excluded by the spike test. The plot title gives the DC-reference of the profile

4. Analysis

4.1. Preprocessing (PREOA)

PREOA select the data that will be used to perform the analysis over each area. All data within the area mask and the time interval defined by date +/-AMPL_OA are selected. At this stage, data might be excluded on the instrument type criteria (INST_EXCL_LIST).

4.1.1. Running PREOA

After setting the parameters in the preoa block of the configuration file, PREOA can be launched in the matlab window.

- config_fname = 'my_DIR_ANA/confisas/config_isas_ana.txt/';
- launch PREOA_main(config_fname, [dd mm yyyy], parameter, plot_display)

An example of perl script to run PREOA_main over several months and years is given in

/isas_v6/perl/ : preoa.pl

4.1.2. The output

PREOA outputs are:

- the temporary files 'fld' and 'dat' for each area, placed in the directory DIR_RUN /preoa /. The 'fld' files contain the empty anomaly filled for the area on the grid. The 'dat' files contain the data to be used by the analysis.

  Naming convention are as follows:

OA_YYYYMMDD _ iarea _typ_PARAM.nc	
OA	identifier for «optimal analyse »
YYYYMMDD	analysis date
iarea	area number
typ	identifier «dat » ou « fld »
PARAM	TEMP ou PSAL

- A copy of the 'dat' and 'fld' files in the data/ subdirectory of DIR_OA_CALCUL if option *copy_preoa=1* is set in the configuration file. If not, run the matlab script PREOA_copy_file separately. DIR_OA_CALCUL is the directory of analysis created in the fortran computer for the analysis step. It is defined in the configuration file.
- The files TEMP.in and PSAL.in that contain the list of the areas to be processed. These files are created by the program PREOA_creat_configin and copied in the subdirectory config of DIR_OA_CALCUL if option creat_in_preoa=1 is set in the configuration file. If not run PREOA_creat_configin separately. An example of TEMP.in and PSAL.in is given in the annexe (8.3.1).
- A log file (8.3.2), which naming convention is as follows:

  preoa_mess_PARAM_yyyymmdd_YYYYMMDDHHMMSS.asc

  where PARAM is the parameter (PSAL, TEMP, ...)

  yyyymmd is the analysis date

YYYYMMDD is the date when the pre-processing has been run

HHMMSS is the hour when the pre-processing has been run

Warning: Erase all files from previous runs in preoa directory berore running PREOA!
The process that copies the files on the fortran computer takes all files found in the directory, files from previous runs which have not been overwritten will be taken into acount and may produce inconsistencies.

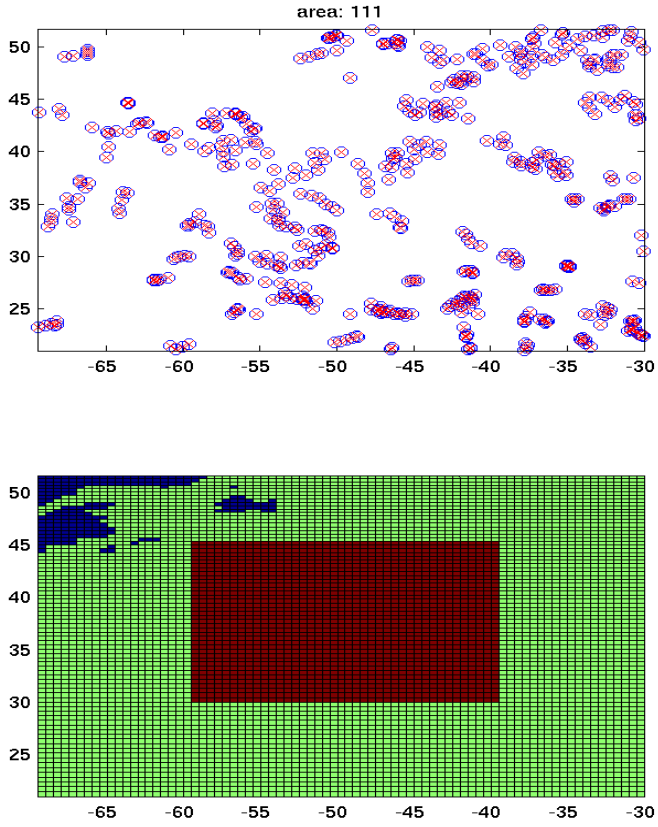

Figure 2: Position of data selected by PREOA to be used for analyzing one area

4.2. Analysis

The analysis must be run on a computer with fortran compiler, Netcdf library and lapack/linpack. The programs (source) must be copied from isas_f90 subdirectory into the ‘software’ directory and compiled for the machine. For files from the subdirectory confstd/climref must be copied into a directory ‘confstd’:

- arglv502_ann_STD_PSAL.nc: a priori variance for the Salinity
- arglv502_ann_STD_TEMP.nc: a priori variance for the Temperature
- ARV09FDS_ann_COVS.nc : Covariance scales caclulated form the Rossby radius.
- bathy_GLOBAL05_v5c2.nc : bathymetrie

A directory ‘my_DIR_ANA_F90’ must be created for each specific analysis. This directory must exist before launching preoa with option 1 for the file copying (see previous section).

4.2.1. Analysis subdirectory on the fortran computer

The analysis directory is shown in the Figure 7. « my_DIR_ANA_F90 » is automatically created by the pre-processing step (the path and name is defined in the configuration file as DIR_OA_CALCUL).

Two directories have to be created by the user in the fortran computer:

- ISAS_F90: contains all the fortran scripts
- confstd: contains the annual variance and covariance, and the bathymetry

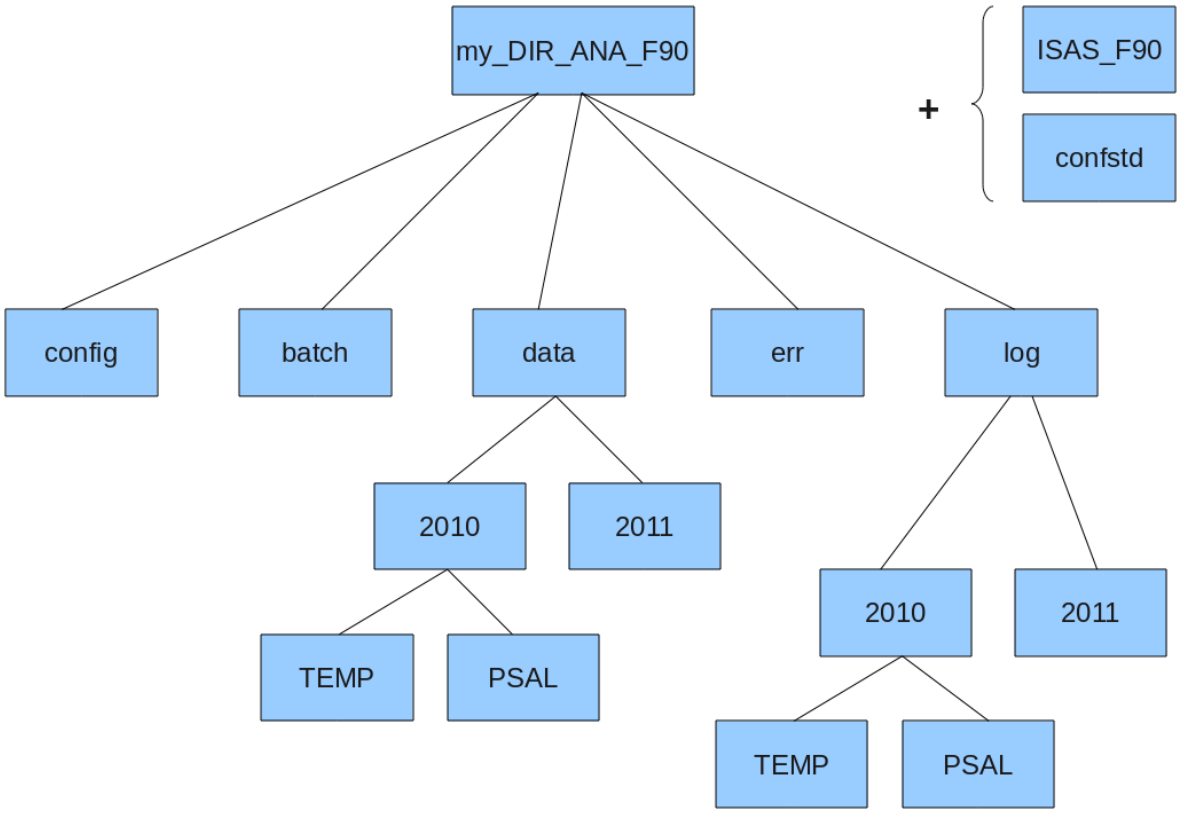

Figure 7: post-processing directories scheme

4.2.1.1. config

Contains the list of area created and automatically copied here by the preprocessing step for each parameter. Nomenclature is PARAM.in, where PARAM is the parameter analysed. Theses files contains the list of NetCDF files to be processed. An example is given in the annexes (8.3.1).

It should also contain the configuration file for the analysis (TEMP.cnf or PSAL.cnf), created here by the user. An example is shown below.

Provided by User

```
TEMP
/home2/mycomputer/user/OA/run/CONFSTD/ISASW_51_STD_TEMP.nc
/home2/mycomputer/user/OA/run/CONFSTD/ISASW_5_ann_COVS.nc
/home2/mycomputer/user/OA/run/CONFSTD/bathy_GLOBAL05_V5_0.nc
300 300 21      % covar_ls  x, y t (in km, km, days)
21              % covar_ms_t (in days)
1  1  4         % var_weigh (LS, MS, UR)
1 1 0 1         % x, y, z, t covariance dependency (1 = yes, 0 = no)
1.2             % fact. Variance
5  12          % QC Max   Mx_std
1.1             % Cov_max (if > 1, no oversampling test)
2        11     % oversample: alpha, fct_test (If fct_test < 10 increases error in the whole area)
```

4.2.1.2. data

Contains the ‘fld’ and ‘dat’ files created (and optionnally copied) by PREOA. Those files will be completed by OA.

4.2.2. Running ISAS_f90

The program can be run in interactive mode:

```
cd my_DIR_ANA_f90
calculateur/isas_f90/OA_main  <  config/TEMP_2011.in
```

It can also be launched in batch mode, this allows to loop over dates and parameters. The way batches are run is machine dependent. Examples are given here for SGI – ICE 8200. To process, launch the batch with:

```
qsub my_DIR_ANA_F90/batch/my_batch
```

where my_batch is as follows (and be created in the directory « batch »):

```
#!/bin/csh
# cd to the directory you submitted your job
cd /home1/caparmor/toto/OARUN/myanalysis/
# get the path for library MKL
source /usr/share/modules/init/csh
module load intel-comp/11.1.073
module load netcdf-intel/3.6.3-11.1.073

date
foreach year (2011)
   foreach month (09 10 11)
      foreach param (TEMP PSAL)
         /export/home1/toto/OA/versions/isas_f90_V6.2_s8/OA_main <
config/$param\_$year$month\15.in
      end
   end
end
```

At the end of the job, a log message like my_batch.o###### appears in the directory my_DIR_ANA_F90/batch. It is a summary of the information written in the log files in the directoy err and log, detailed in the following.

4.2.3. Outputs

4.2.3.1. err

Contains a short log file with the list of processes files and any error message issued by the

program. This file must be screened carefully to check that the processing has ended normally. An example is given in the Annexes (8.4.1).

4.2.3.2. log

Created by ISAS

The log file contain statistical information on the processing for each area and each level of analysis. An example is given in the Annexes (8.4.2).

4.2.3.3. data files

Created by ISAS

The analysis results are stored in the directory « data', with the ‘fld’ and ‘dat’ data files that now contain the gridded anomaly fields and corresponding error and the data residuals, respectively.

4.3. Post-Processing (POSTOA)

During this last part of the processing, the program concatenates all processed areas and datasets. It also convert anomalies to absolute values. The files are read in DIR_OA_CALCUL (here, my_DIR_ANA_F90/data) and results are written in DIR_ANA_RESU (here, DIR_RESU).

4.3.1. Running POSTOA

POSTOA is launched with the same arguments as PREOA. In the matlab window:

- config_fname = ’my_DIR_ANA/confisas/config_isas_ana.txt/’;
- launch POSTOA_main (config_fname, [dd mm yyyy], parameter, plot_display)

An example of perl script to run POSTOA_main over several month and years is given in the doc directory.

4.3.2. Outputs

The results are saved in two files:

- In DIR_RESU/data, the NetcCDF ‘dat’ file that contains the data and residuals used by all the areas .
- In DIR_RESU/field the NetCDF file ‘fld’ that contains the global 3D gridded fields and error.

File naming convention is as follows:

myanalysis_YYYYMMDD_ typ_PARAM.nc
myanalysis analysis identifier (ANA_NAME in the config file)
YYYYMMDD analysis day (if DD='00', analysis month)
typ identifier «dat » ou « fld »
PARAM the parameter TEMP or PSAL

The processing can be checked by looking at the log files and plots.

The log file has the following naming convention, and an example is given in the annexe (8.5).

postoa_mess_PARAM_yyyymmdd_YYYYMMDDHHMMSS.asc

where PARAM is the parameter (PSAL, TEMP, ...)

yyyymmd is the analysis date

YYYYMMDD is the date when the pre-processing has been run

HHMMSS is the hour when the pre-processing has been run

The plots are stored in DIR_RUN/plotisas/postoa. The nomenclature is :

postoa_myanalysis_yyyymmdd_PARAM.png

where myanalysis is the analysis identifier (ANA_NAME in the config file)

yyyymmdd is the analysis date

PARAM is the parameter (PSAL, TEMP, ...)

Each plot contains four axes, as shown in the figure 8:

- the data position
- the error
- the anomaly
- the final field

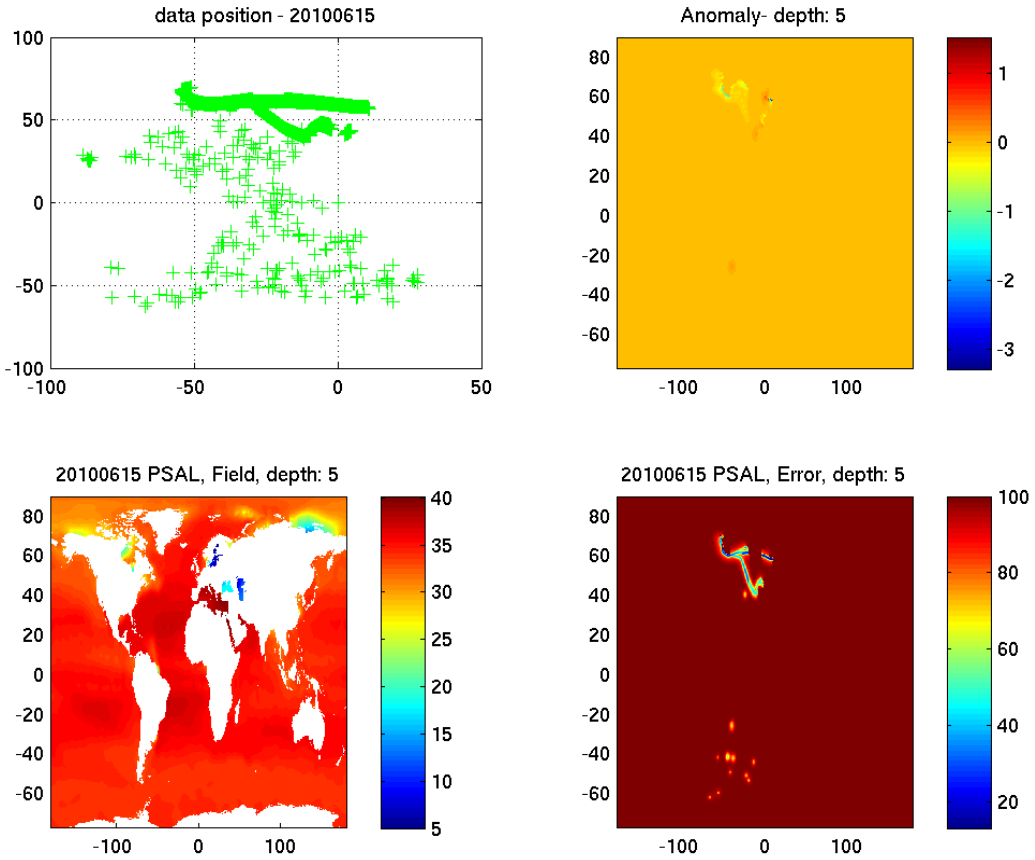

Figure 8: example of post-processing plot, from an analysis of june 2010, only in the Atlantic. Top, from left to rigth: data position, and anomaly at 5m depth. Bottom from left to rigth: field and error at 5m depth.

5. Matlab_isas

5.1. The pre-processing of data files (STD program)

This step reads the NetCdf files provided by Coriolis, or prepared by the user according to a specific format. Profiles with valid data are selected and depth is computed if not present in the file, then two automatic controls are performed: comparison to climatology and spike detection. Points that fails the control are not used. Finally the profiles are interpolated on the analysis standard levels and the final STD NetCdf files are saved.

The main program is STD_main.m.

		calls
STD_main	Main function to prepare the dataset for the analysis reads Raw files and creates STD files Syntax: [] = STD_main(config_fname, DATE_INPUT, DAY_NUMBER, i_pass, PLOT_DISP)	STD_list_PR STD_list_TS STD_list_hyd STD_conv_raw STD_red_list STD_red_mean rep_definition ISAS_MSG flddat_init var2analyse count_data NCW_data_hdr NCW_data_var NCW_data_mult
STD_list_PR	Builds list of raw files to read and the list of the corresponding standardised files. The files are downloaded from Coriolis database, in NetCDF Argo format for daily files.	none
STD_list_TS	Build list of Time series raw files to read, and the list of the corresponding standardised files. The raw files must be in NetCDF Gosud format.	none
STD_list_hyd	Not used yet	
STD_conv_raw	STD_conv_raw Creates standard files from raw profiles (Coriolis or user defined NC-files) 1 - Extracts valid profiles from 'RAW' file 2 - Computes depths when only pressure is provided 3 - Adds climatology mean and std profiles and checks profile against climatology and looks for spikes 4 - Interpolates to standard levels:	STD_read_PR STD_read_TS STD_read_hyd STD_count STD_deph STD_clim_check STD_spike_check STD_plt_err STD_vert_bins STD_vert_ext_TS STD_vert_interp

		STD_TS_control_plot STD_PR_control_plot ISAS_MSG Var2analyse count_data NCR_OA_field
STD_red_list	Provide a list of profiles to average 1 - looks for platforms with multiple profiles 2 - tests vicinity of multiple profiles 3 - defines the groups of profiles	none
STD_red_mean	Compute average profiles: Averages profiles from the same platform according to list provided by STD_red_list	count_data UT_prof_avg
STD_read_PR	STD_read_PR: Reads and extracts valid profiles (QC, area and time period) from file FILE_raw_i. Select raw values or adjusted values	ISAS_MSG var2analyse STD_read_PR_data count_data STD_red_list STD_red_mean
STD_read_PR_data	Select valid data according to QC list and fill_value.Raw data are « Profiles » data.	none
STD_read_TS	Reads and extracts valid profiles from time series files	ISAS_MSG var2analyse STD_read_TS_data count_data
STD_read_TS_data	Select valid data from « TimeSeries » Nc file according to area and QC list.	none
STD_read_hyd	Not used	
STD_count	counts valid profiles and redefine flags:	none
STD_deph	Compute depth when only pressure is provided by interpolating the depth/pressure profile of the nearest grid point of the climatology	NCR_OA_field
STD_clim_check	Check each profile against climatology using the standard deviation. Eliminated data are flagged 4.	none
STD_spike_check	Check spikes in each profile. The spike test looks for: 1) a significative change in the sign of the first derivative 2) high values of the second derivative - (normalized) Eliminated data are flagged 5	none
STD_plt_err	Plot and save error plots	none
STD_vert_bins	Averages the data into bins centered on STD	UT_vert_bin

	levels	
STD_vert_ext_TS	Extrapolate the TSG data from the level of measurement up to the surface	none
STD_vert_interp	Interpolate profiles when nb_data points > NB_INT_MIN - Flags the data according to interval betwen data points - Increase error by a factor sqrt(QC)	none
STD_control_plot_PR	Control plot for profiles	none
STD_control_plot_TS	Control plot for time series	none

5.1.1. STD_main.m

Main function to prepare the dataset for the analysis reads Raw files and creates STD files

Syntax:

[] = STD_main(config_fname, DATE_INPUT, DAY_NUMBER, i_pass, PLOT_DISP)

Input arguments

- **config_fname**: full name of the configuration file
- **DATE_INPUT**: date of the analyse (format : [dd mm yyyy]). dd could be equal to 0 if you consider the full month mm.
- **DAY_NUMBER**: number of day for the analysis (STD_main input argument). If you want to consider the full month mm, set DAY_NUMBER to 0.
- **i_pass:** i_pass = 1 for a strict window profile selection, in order to detect suspicious one. i_pass = 2 for an enlarged window, as the suspicious one are considered controlled and get off the raw set if needed. Generally, STD_main is made first with i_pass = 1. The alerted profiles are controlled. Then a second run of STD is made, with i_pass = 2.
- **PLOT_DISP**: Plotting option makes figure visible or not, the figure are saved anyway. PLOT_DISP=0 : no display, PLOT_DISP=1 : display

Output arguments

There is no output argument. The standardisation is made, and the standardised files are created with the name and in the directory defined in the config_fname.

5.2. Pre- and Post analysis (PREOA/POSTOA)

The main programs are PREOA_main and POSTOA_main.

PREOA_main	prepares the dataset that will be used to perform the analysis for the parameter and the list of areas prescribed in the config file. All data within the area area mask and the time interval defined by date +/-dtime_ana are selected	rep_definition NCR_OA_field PREOA_file_list NCR_data PREOA_append PREOA_select

		PREOA_copy_file globatt_init NCW_data_hdr NCW_data_var NCW_OA_field
PREOA_file_list	Builds dates list corresponding to STD files.	none
PREOA_append	Appends new dataset to structures OAHDR and OAVAR	none
PREOA_select		none
PREOA_copy_file	Copies dat and fld NetCdf files created by PREOA on the remote computer Creates the config file with list of NetCDF files to use and copiesthem to the remote computer	PREOA_copy_list
PREOA_copy_list	Copy a list of files from dir_in to dir_out	none
POSTOA_main	1- Collects data from all area files and saves a unique data file. % 2 - Merge field areas to form the global anomaly. Filters the field and % error where error is above threshold. Add to climatology and save the % final global parameter fieldFilters field and error on area boundaries where error is above threshold	rep_definition flddat_init NCR_data PREOA_select NCW_data_hdr NCW_data_var NCR_OA_field POSTOA_filter NCW_OA_field
POSTOA_filter	Filters field and error on area boundaries where error is above threshold	none

5.2.1. PREOA_main.m

Main function to prepare the dataset that will be used to perform the analysis over each area, and for one parameter. All data within the area mask and the time interval defined by date +/-AMPL_OA are selected. Two classes of files are created: he temporary files 'fld' and 'dat'.

- The 'fld' files contain the empty anomaly fields for the area on the grid.
- The 'dat' files contain the data to be used by the analysis.

Syntax:

[] = PREOA_main(config_fname, DATE_EST, PARAM, PLOT_DISP)

Input arguments

- **config_fname**: full name of the configuration file
- **DATE_EST**: date of the analyse (format : [dd mm yyyy])
- **PARAM**: parameter to be pre-processed (PSAL, TEMP, DOXY, ...)
- **PLOT_DISP**: Plotting option makes figure visible or not, the figure are saved anyway. PLOT_DISP=0 : no display, PLOT_DISP=1 : display

Output arguments

No output argument. The pre-processing is made. Pre-processed files are created with the name and in the directory defined in config_fname.

5.2.2. POSTOA_main.m

The area files created by PREOA and completed by the analysis OA are processed to form global « .fld » and « .dat » files.

POSTOA_main

- Collects data from all area files and saves a unique data file.
- Merges field areas to form the global anomaly. A smoothing of the areas boundaries can be made where error is above a specified threshold. Finally, the anomaly is added to climatology to form the final field of the analyzed parameter.

Syntax

[] = POSTOA_main(config_fname, DATE_EST, PARAM, PLOT_DISP)

Input arguments

- **config_fname**: full name of the configuration file
- **DATE_EST**: date of the analyse (format : [dd mm yyyy])
- **PARAM**: parameter to be pre-processed (PSAL, TEMP, DOXY, ...)
- **PLOT_DISP**: Plotting option makes figure visible or not, the figure are saved anyway. PLOT_DISP=0 : no display, PLOT_DISP=1 : display

Output arguments

No output argument.

Post-processed files are created with the name and in the directory defined in config_fname.

A control plot is saved in the directory ISAS_RUN/plotisas/postoa

5.3. Tools

These matlab programs are used in each of the three steps standardisation, pre- and post-processing. They are sorted in alphanumerical order.

rep_definition		
flddat_init		
var2analyse		
count_data		
NCR_OA_field		
NCW_data_hdr		
NCW_data_var		
NCW_data_mult		

NCW_OA_field		
UT_vert_bin		

5.3.1. NCR_data.m

Select usefull data read in STD files, or '.dat' files. Used in PREOA_main and POSTOA_main.m.

Function

[STDHDR, STDVAR, STDQC] = NCR_data(fnam_data, PARAM, iopt_nan, pltnum, jlim, tab_msk, lat_msk, lon_msk)

Input arguments

- **fnam_data**: full name of the file to be read
- **PARAM**: parameter name (PSAL, TEMP, ...)
- **iopt_nan**: If iopt_nan is set to 1, the program replaces fill_value with NaN

optional arguments:

- **pltnum**: platform number (character). If pltnum = '0': no platform selection
- **jlim**: time limits in julian days
- **tab_msk**: geographical mask of the considered area (only sea = 2, only land = 0, sea and land = 1)
- **lat_msk**: latitudes of the considered area
- **lon_msk**: longitudes of the considered area

Output arguments

- **STDHDR**: structure with metadata and global attributes of the file fnam_data
- **STDVAR**: structure of data of the file fnam_data
- **STDQC**: structure with QC and DCref information (reduction, ...) of the read file

5.3.2. NCR_OA_field.m

Reads parameter field and coordinates from nc file.

Function

[lon_ana, lat_ana, dep_ana, param_OA, pct_var] = NCR_OA_field(file_nc_OA,PARAM,list_level,ilim,jlim)

Input arguments

- **file_nc_OA**: full name of the file to be read
- **PARAM**: parameter name (PSAL, TEMP, ...)

optional arguments:

- **list_level**: list of depth levels to be read

  absent : read all the depth levels

0 : read only the coordinates

-1 : read all the depth levels

-n : read depth levels from 1 to n

else: read depth levels listed in list_level

- **ilim**: min and max latitude to be read; if absent: all the latitude domain is read
- **jlim**: min and max longitude to be read; if absent: all the longitude domain is read

Output arguments

- **lon_ana**: longitude read in the field file
- **lat_ana**: latitude read in the field file
- **dep_ana**: depth read in the field file
- **param_OA**: data read, corresponding to the parameter PARAM
- **pct_var**: variance percentage, corresponding to the parameter PARAM

5.3.3. NCW_data_hdr.m

Write headers (metadata) and their atytributes in data file that is created here.

[msg_error] = NCW_data_hdr(ncfile_name, GLOB_ATT, STDHDR)

Input arguments

- **ncfile_name**: the full name of the file to be created
- **GLOB_ATT**: global attributes structures.
- **STDHDR**: structure with metadata and global attributes of a standardised file or of a '.fld' analysed file.

Output arguments

No output argument, except a message. The file is completed.

5.3.4. NCW_data_var.m

Writes data of the variable PARAM in data file. Used after NCW_data_hdr that creates the data file.

Function

[msg_error] = NCW_data_var(ncfile_name, PARAM, STDVAR)

I**nput arguments**

- **ncfile_name**: full name of the file to be completed. File created by NCW_data_hdr.
- **PARAM**: parameter to be written (PSAL, TEMP, ...)
- **STDVAR**: structure with the data of the file ncfile_name, for the parameter PARAM

Output arguments

No output argument, except a message. The file is completed.

5.3.5. NCW_OA_field.m

This function creates and write the '.fld' NetCDF files. These files contains fields : 3D grid (time, lat, lon) and the time.

Function

[msg_error] = NCW_OA_field(OA_filename, PARAM, GLOB_ATT, longitude, latitude, depth, jul_rel, FIELD, ERROR)

Input arguments

- **OA_filename**: Full name of file to be created
- **PARAM**: parameter ('TEMP', 'PSAL', 'TPOT','SIG0','TEMP_STD','PSAL_STD')
- **GLOB_ATT**: structure setting the global attributes
- **longitude**: Vector of longitudes (its length defines the longitude dimension)
- **latitude**: Vector of latitudes (its length defines the latitude dimension)
- **depth**: Vector of depth (its length defines the depth dimension)
- **jul_rel**: Julian day referenced to the Reference Date Time read in the standardised file (most of the time, 01/01/1950).
- **FIELD** : 3D gridded field FIELD(longitude, latitude, depth) and time
- **ERROR**: 3D gridded field of error define as percent variance

Output arguments

No output argument, except a message. The file is written.

6. Optimal interpolation: (f90_isas)

6.1. Program list

OA_main.f90	Main program for Objective Analysis Coordinates loop over areas	OA_anaarea
OA_anaarea	Analysis of a field on a regular grid for one area	OA_ncreaddim OA_ncreadstat OA_ncreaddata OA_covini OA_oversamp OA_calsol OA_ncwrite_fld OA_ncwrite_dat
OA_ncreaddim	Reads dimensions in nc file prepared by pre-OA	none
OA_ncreadstat	Reads field grid and covariances in nc file prepared by pre-OA	none
OA_ncreaddata	Reads data in nc file prepared by pre-OA	none
OA_covini	Prepares covariance matrices by computing the distance dependent part	none
OA_oversamp	Computes weights to increase error in case of oversampling	none
OA_calsol	Computes OA solution: (X_est - X_0) = Koa (Y – Y_0), Koa = C_md (C_dd + R)**-1, diag(C_est) = R = diag(data_var), where: Y _ Y_O : dino X_est - X_0 : ana_fld diag(C_est) : ana_var_ps	none
OA_ncwrite_fld	Writes analysis results in nc file prepared by pre-OA: gridded field	none
OA_ncwrite_dat	Writes analysis results in nc file prepared by pre-OA: data vector and residuals	none

7. References

Brion E., F. Gaillard, L. Petit de la Villéon, T. Delcroix, G. Alory, G. Reverdin, 2011. Collecting and gridding complementary in-situ SST/SSS data for the calibration and validation of SMOS. *Article in the Newsletter Mercator-Coriolis, april 2011*

Brion, E., F. Gaillard, 2011. ISAS-Tool Version 6: programs. *Rapport LPO.*

Brion, E., F. Gaillard, 2011. ISAS-Tool Version 6: User's manual. *Rapport LPO*

Gaillard, F., 2011. ISAS-Tool Version 6: Configuration. *Rapport LPO*

Gaillard, F., E. Autret, V.Thierry, P. Galaup, C. Coatanoan, and T. Loubrieu , 2009. Quality control of large Argo data sets. *JOAT, Vol. 26, No. 2. 337–351*

Bretherton, F., R. Davis, and C. Fandry, 1976. A technique for objective analysis and design of oceanic experiments applied to Mode-73. *Deep Sea Research, 23, 1B, 559--582.*

Charraudeau, R. and F. Gaillard, 2007. ISAS_V4: Mise en place de la configuration. *Rapport LPO 07-09, 88 p.*

8. ANNEXES

8.1. Configuration file

```
%================================================================
%                  Configuration file for ISAS-V6
%                  F. Gaillard, LPO/Ifremer
%                  E. Brion, LPO/CNRS
%================================================================
%  Attention: no space within lines (unless necessary)
%================================================================
% Language: EN or FR
LANG=En
%================================================================
%
% Metadata information for NC files
DATA_SET=YYYYYYY
INSTITUTION=XX/IFREMER
PROJECT_NAME=MyProgName
DATA_MANAGER=You
SOURCE=ISAS-V6
%================================================================


%================================================================
% Directory and file names for standard configuration
%================================================================

% Configuration files: Climatology, STD, areas
% ------------------------------------------
DIR_CONFSTD=/net/toto/export/home1/arivo/software/isas/isas_ana/confstd_v
5c3/
nam_clim=arglv502
nam_std=arglv502_ann_STD
nam_bathy=bathy_GLOBAL05_v5c2.nc

%   RAW DATA
%   --------
% Raw data directory and files prefix for profiles - Coriolis files
DIR_RAW_ROOT_PRC=/net/mymachine/export/home1/DATA_WORK/NRTOAGL01/
PRF_RAW_PRC=CO_NRTOAGL01_

% Raw data directory and files prefix for profiles - User files (hydro or
profilers)
%DIR_RAW_ROOT_PRU=/net/mymachine/export/home1/DATA_WORK/NRTOAGL01/
```

```
%PRF_RAW_PRU=CO_NRTOAGL01_

% Raw data directory and files prefix for time series-TSG
DIR_RAW_ROOT_TSG=/net/toto/export/home1/SOERE-CTDO2-
TSGRecherche/NRTGV2_nc/

% Raw data directory and files prefix for time series-buoys
% DIR_RAW_ROOT_TSB
% Raw data directory and files prefix for time series-moorings
% DIR_RAW_ROOT_TSM

%   STD DATA
%   --------
% STD data directory and files prefix for Profiles
DIR_STD_ROOT_PR=/net/mymachine/export/home1/std_data_NRT/isasv6xx_PR/
% PRF_STD  : Prefix for  std files
PRF_STD_PR=ST_isasv6xx_

% STD data directory and files prefix for TIMESERIES
DIR_STD_ROOT_TS=/net/mymachine/export/home1/std_data_NRT/isasv6xx_TS/
PRF_STD_TS=ST_isasv6xx_

%  Analysis
%  ---------
% Directory for Analysis results and logs
DIR_ANA_ALL=/net/mymachine/export/home1/analysis_NRT/isasv6xx/
DIR_ANA_RESU=/net/mymachine/export/home1/analysis_NRT/isasv6xx/ISAS_RESU/
DIR_ANA_RUN=/net/mymachine/export/home1/analysis_NRT/isasv6xx/ISAS_RUN/

% Directory for f90 computer
DIR_OA_CALCUL=/net/caparmor-nas/mnt/data2/home1/you/OARUN/arglv6XX/

%==================================================================

str_area_limits=[-81 +90 -180 +180]

%==================================================================



%==================================================================
%  STD: Standardisation
%==================================================================

% TYP_LIST: List of file types to process
TYP_LIST=PR_CT,PR_PF,PR_TE,PR_XB,PR_MO,PR_BA
%TYP_LIST=PR_PF,PR_CT,PR_MO,PR_TE

GREY_LIST_STD=model_greylist.txt

% Definition of default measurement error associated with each file type
s
% Will be used if no error information is found in the file
PR_TE_ERR=0.03
PR_BA_ERR=0.05
PR_PF_ERR=0.01
PR_XB_ERR=0.03
PR_CT_ERR=0.01
```

```
PR_MO_ERR=0.01
PR_BH_ERR=0.002
TS_TS_ERR=0.02

% month_grp=1   : all data within a month are grouped, no group = 0
month_grp=1

%  Variables to analyse (lower case)
VAR=psal,temp
%  Variables to analyse, specific to timeSeries(lower case)
VARtimser=ssps,sstp

% use_adjust=1  : use adjusted value if exist (else: =0)
use_adjust_PR=1
use_adjust_TS=0

% Datacenter QC used
%-----------------------------------------------------------------
%  Datacenter QC are the following:
%0 No quality control (QC) was performed.
%1 QC was performed: good data.
%2 QC was performed: probably good data.
%3 QC was performed: probably bad data.
%4 QC was performed: bad data.
%5 The value was changed as a result of QC.
%8 Interpolated value
%9 The value is missing
%
% QC_TS: flags ok Temp and Psal
% QC_ZP: flags ok Pres and depth
% QC_XY: flags ok Position and date
%   Temporarilly two sets: char for Argo, num for TSG
%  uses also error max to select data
QC_TS=125
QC_ZP=0 125
QC_XY=0 125
QC_TS_num=1,2,5
QC_ZP_num=0,1,2,5
QC_XY_num=0,1,2,5

ERR_MAX_PRES=20
ERR_MAX_TEMP=1
ERR_MAX_PSAL=1
%- ----------------------------------------------------------------

% ---------------------------------
%  Parameters for profiles controls
%  ---------------------------------
% Criteria for comparaison with climatology and spike detection
% The processing is performed in two passes, so 2 values are proposed.
% The maximum deviation realtive to the reference climatology is defined
by
% crit_std_clim: that sets the number of standard deviations allowed for
climatology comparison
% alpha_clim:   that add a tolerance to take into account the strong
stratifications
% crit_spike:  that sets the number of standard deviations allowed for
spike detection.Number of
```

```
%               value depending on the number of variable analysed.
%
% Pass1 recommended values, for TEMP and PSAL parameter analysis
% crit_std_clim_1=6
% alpha_clim_1=2
% crit_spike_1=100,100
%
% Pass2
% crit_std_clim_2=80
% alpha_clim_2=10
% crit_spike_2=2000,2000

str_crit_std_clim_1=6
str_alpha_clim_1=2
str_crit_spike_1=100,100

str_crit_std_clim_2=80
str_alpha_clim_2=10
str_crit_spike_2=1000,1000

% INT_NB_MIN : Minimum number of data points for interpolating a profile.
INT_NB_MIN=5


%  Parametres for the reduction of nearby profiles
%  -----------------------------------------------
% str_red_opt24 =1: applies 24h average of 1 level profiles
% RED_DXMAX: maximum allowed distance (km)
% RED_DTMAX: maximum allowed interval of time (days)
% str_red_qcmax: maximum quality flag of interpolation taking into
account to make the
%                 average profiles.
str_red_opt24=1
RED_DXMAX=15
RED_DTMAX=7
str_red_qcmax=4

% NPROF_MAX: Maximum number of raw profiles found to form one std file
NPROF_MAX=90000
% NTIMS_MAX: Maximum number of raw TSG found to form one std file
NTIMS_MAX=1000000

%  str_plot_std    % Plotting option for STD
% 0 = no plots,
% 1 = summary plot + alert plot,
% 2 = 1 + ctrl plot
% 3 = 2 + plot each profile + pause
str_plot_std=1

% Specifique 'TSG'
% ---------------------------------
% FILE_LIST : list of raw files to explore (file.txt) corresponding to
% the list of TSG files of the DIR_RAW_ROOT_TSG
FILE_LIST=TS_raw_list.txt

% LEV_SURF : level of standardisation
LEV_SURF = [0:20]
```

```
% Definition of the erro multiplicative factor for the surface processing
ERR_COEF=[1.5 2]

%==================================================================


%==================================================================
%  PREOA: Preprocessing
%==================================================================

% ANA_AREA_LIST: list of geographical areas to analyze
str_listarea_ana=[101:141,201:241,301:388,401:403,501:506];

% AMPL_OA: time interval around date of analysis in days
%   data from jest-dtime_ana to jest+dtime_ana will be used
%str_dtime_ana=41
str_dtime_ana=41

% Levels selected for the analysis
% str_deph_ana=-1 : no selection, keep all the levels.
% str_deph_ana=[0, 5, 20, 100]: list of STD levels to analyze
%                    (the closest standard levels will be selected
str_dep_ana=-1

% str_qcmax_ana: max STD-QC taken into account (scale: QC_interp)
str_qcmax_ana=4

% Instrument type excluded
%INST_EXCL_LIST=[(1:800),900] : exclude XBTs of all types
%INST_EXCL_LIST=[]
str_list_excl_inst=[(1:800),900]

% After PREOA, copies NetCDF files on the remote computer
%               and creates config files
%                1 = yes
str_copy_preoa=1

%==================================================================


%==================================================================
%  POSTOA: Post-Processing
%==================================================================
% Analysis name
ANA_NAME=ARGLV6XX

% clim_ref_oa=M (month) or clim_ref_oa=Y (year)
clim_ref_oa=M

% Spatial filtering allowed on point with err>err_max
str_filter_errmax=80

%for plotting : level (in meter) to be plotted by post-oa, if PLOT_LEV <
0, no plot
str_plot_lev=5

%==================================================================
```

8.2. log files of the standardisation step

8.2.1. message file

```
 >>>>>>>  Running ISAS_V6/STD

 Last update :20-Dec-2011 16:03:12
 Configuration files :
climref: /home5/garo/arivo/software/isas/isas_ana/confstd_v5c3/climref/
bathy:   /home5/garo/arivo/software/isas/isas_ana/confstd_v5c3/climref/
area:    /home5/garo/arivo/software/isas/isas_ana/confstd_v5c3/areadef/

  Type_list:
PR_PF
PR_CT
PR_MO
PR_TE

 RAW data directory: /net/luarca/export/home1/DATA_WORK/NRTOAGL01/
 STD data directory: /net/luarca/export/home1/std_data_NRT/arglv6NRT_PR/

 -------------------------------------
    STD: Type PR_PF,  31 files found
 -------------------------------------
/net/luarca/export/home1/DATA_WORK/NRTOAGL01/2011/CO_NRTOAGL01_20110101_PR_PF.nc
/net/luarca/export/home1/DATA_WORK/NRTOAGL01/2011/CO_NRTOAGL01_20110102_PR_PF.nc
/net/luarca/export/home1/DATA_WORK/NRTOAGL01/2011/CO_NRTOAGL01_20110103_PR_PF.nc
/net/luarca/export/home1/DATA_WORK/NRTOAGL01/2011/CO_NRTOAGL01_20110104_PR_PF.nc
...
...
 /net/luarca/export/home1/DATA_WORK/NRTOAGL01/2011/CO_NRTOAGL01_20110131_PR
_PF.nc


  ********  File    1  ********

 Starting STD_convprof

 Starting STD_read_Prof  - File processed: CO_NRTOAGL01_20110101_PR_PF
   Number of profiles found in file            :271
   Number of profiles with valid position/time :271

  STD_read_xxdata output: selection of raw/adjusted profiles
   Variable:psal, Nb raw profiles QC ok :   127, Nb elements QC ok :
16063
                , Nb adj profiles QC ok :   144, Nb elements QC ok :
11293
   Variable:temp, Nb raw profiles QC ok :   125, Nb elements QC ok :
16253
                , Nb adj profiles QC ok :   146, Nb elements QC ok :
11497
   Variable:pres, Nb raw profiles QC ok :   125, Nb elements QC ok :
16255
                , Nb adj profiles QC ok :   146, Nb elements QC ok :
11518
   the variable deph does not exist
 STD_read_Prof end
  Number of profiles with valid S/T data (good QC and no NaN): 271
```

```
   distribution per type: S: 0, T: 7, S/T: 264,

  Number of profiles without deph: before 271,   after 0
  Number of profiles with valid S/T data (good QC and no NaN): 271
   distribution per type: S: 0, T: 7, S/T: 264,

  Number of profiles with std-alert S: 0, T: 0
  Number of profiles with valid S/T data (good QC and no NaN): 271
   distribution per type: S: 0, T: 7, S/T: 264,

  Interpolation on std_levels
  Number of profiles with valid S/T data (good QC and no NaN): 271
   distribution per type: S: 0, T: 7, S/T: 264,
   271 profiles, CPU time total (seconds):  87.84
       CPU read:   0.36, deph:  26.62, STD check:  53.83, Stdlev:  34.01


  ********  File    2  ********

 Starting STD_convprof

 Starting STD_read_Prof  - File processed: CO_NRTOAGL01_20110102_PR_PF
   Number of profiles found in file            :252
   Number of profiles with valid position/time :252

......
```

8.2.2. summary file

```
***   std_summary: 20110701_20111109102322



<<<
================================================================================
=====
<<<  Final number of profiles per type:
<<<
--------------------------------------------------------------------------------
-----
<<<        before time/space reduction                    after reduction
<<< Nfound  NokST   NnoZ  Nalert N_pstd    NS     NT     NST Total
<->   9494   9471     12      5   9459      0    236   8826   9062
ST_arglv6NRT_20110700_PR_PF.nc
<->   1635   1426    131      1   1295      0     10    250    260
ST_arglv6NRT_20110700_PR_CT.nc
<->   2796   2796      0      0   2796      0     55    395    450
ST_arglv6NRT_20110700_PR_MO.nc
<-> 113857  36266      0      0  36266      0    535   2048   2583
ST_arglv6NRT_20110700_PR_TE.nc
>>>
================================================================================
=====
```

8.3. output files of the pre-processing step

8.3.1. List of area processed : example with a PSAL.in

```
data/2010/PSAL/$
log/2010/PSAL/$
config/PSAL.cnf$
32
OA_20100615_101_dat_PSAL.nc
OA_20100615_103_dat_PSAL.nc
OA_20100615_105_dat_PSAL.nc
OA_20100615_106_dat_PSAL.nc
OA_20100615_107_dat_PSAL.nc
OA_20100615_109_dat_PSAL.nc
OA_20100615_110_dat_PSAL.nc
OA_20100615_111_dat_PSAL.nc
OA_20100615_112_dat_PSAL.nc
OA_20100615_113_dat_PSAL.nc
OA_20100615_115_dat_PSAL.nc
OA_20100615_116_dat_PSAL.nc
OA_20100615_117_dat_PSAL.nc
OA_20100615_118_dat_PSAL.nc
OA_20100615_120_dat_PSAL.nc
OA_20100615_122_dat_PSAL.nc
OA_20100615_123_dat_PSAL.nc
OA_20100615_124_dat_PSAL.nc
OA_20100615_125_dat_PSAL.nc
OA_20100615_126_dat_PSAL.nc
OA_20100615_127_dat_PSAL.nc
OA_20100615_129_dat_PSAL.nc
OA_20100615_130_dat_PSAL.nc
OA_20100615_131_dat_PSAL.nc
OA_20100615_133_dat_PSAL.nc
OA_20100615_134_dat_PSAL.nc
OA_20100615_135_dat_PSAL.nc
OA_20100615_136_dat_PSAL.nc
OA_20100615_137_dat_PSAL.nc
OA_20100615_138_dat_PSAL.nc
OA_20100615_140_dat_PSAL.nc
OA_20100615_141_dat_PSAL.nc
```

8.3.2. log file

```
>>>>>>>  Running ISAS_V5.3b/PREOA

 Last update :30-May-2011 14:18:32
 STD_PRO:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/

 STD_TIMSER:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/

 PREOA:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/ISAS_RUN/
preoa/

  nb area:   41, nb_std:   5, param: TEMP

 File dates:
  20100500
```

```
  20100600
  20100700
  20100800
  20100000

 File types :
  PR_PF
    TSG

 ***** Starting area  101 *****
 File:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/2010/S
T_expmodlest_20100600_PR_PF.nc
          7 data
 File:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/2010/S
T_expmodlest_20100600_TSG.nc
        278 data

 0 data removed on type criteria

Ok: NCW_data_hdr
Ok: NCW_data_var
Ok: NCW_data_mult
OK: NCW_OA_field

   area  101, nb_data:   285, nb_prof_tot:   3281, processing time:  33.55 sec
  ***********************************************

 ***** Starting area  102 *****
 File:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/2010/S
T_expmodlest_20100600_PR_PF.nc
          0 data
 File:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/2010/S
T_expmodlest_20100600_TSG.nc
          0 data

   area  102, nb_data:     0, nb_prof_tot:      0, processing time:   0.04 sec
  ***********************************************

 ***** Starting area  103 *****
 File:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/2010/S
T_expmodlest_20100600_PR_PF.nc
          0 data
 File:
/net/spineg/export/home/ebrion/ISAS/ANALYSES/ARGLV5TEST/EXP_MODIF_LEST/std/2010/S
T_expmodlest_20100600_TSG.nc
        223 data

 0 data removed on type criteria

Ok: NCW_data_hdr
Ok: NCW_data_var
Ok: NCW_data_mult
OK: NCW_OA_field

   area  103, nb_data:   223, nb_prof_tot:   1614, processing time:  26.75 sec
  ***********************************************

...
```

```
...
...

  ISAS_V5.3b/PREOA processing done
```

8.4. log and error file for the Analysis fortran step

8.4.1. error file

```
 ================================================================
     Run: OA_20100615_PSAL
           OA-Version 5.1
 ================================================================

    PARAM: PSAL, nb_area:   32


  Configuration files used:
  -------------------------
  A-priori variance :
/home1/caparmor/fgaillar/OA/CONFSTD-V5C3/arglv502_ann_STD_PSAL.nc
  Covariance scales :
/home1/caparmor/fgaillar/OA/CONFSTD-V5C3/ARV09FDS_ann_COVS.nc
  Bathymetry :
/home1/caparmor/fgaillar/OA/CONFSTD-V5C3/bathy_GLOBAL05_v5c2.nc


 Parameters for optimal estimation:
 ----------------------------------
 Large scale covariance (x,y,t):   300000.0  300000.0    30.0
 Meso scale covariance (t)      :     30.0
 Variance weights (LS, MS, UR) :    1.0   2.0   6.0
 Covariances used (x, y, z, t) :  1 1 0 1
 Factor multiplying apr-var    :  1.5
 qc_max, mx_std:                   5  12
 Oversampling: cov_max, alpha, fct_test:  0.98000  2.00  11.0


  Analysis name:OA_20100615_101_dat_PSAL

  Analysis name:OA_20100615_103_dat_PSAL

  Analysis name:OA_20100615_105_dat_PSAL

  Analysis name:OA_20100615_106_dat_PSAL

  Analysis name:OA_20100615_107_dat_PSAL

  Analysis name:OA_20100615_109_dat_PSAL
 ...
 ...

  Analysis name:OA_20100615_141_dat_PSAL
   4.50828230381012
```

8.4.2. log file

Example for the file: OA_20100615_101_dat_PSAL.log

```
*****   Area:  101,       Nb_profiles:   285
                             Nb_level:   152
      Nb_analysis points: (nlon,nlat):    71   90
      Nb_Bathy points:    (nlon,nlat):   720  545

    OA_anaarea: statistics OK
    OA_anaarea: data OK
  cpu distance calculations:  0.068

 Level:    1, Nb_ana_points:  3240, Nb_data:   272
              Nb_ovsamp:     89,  fact_mult:    1.00, fact_mult2:    1.00
     ano_max:  16.123, inov min:  -3.747, inov max:   0.837
                       fld  min:  -1.733, fld  max:   0.005
                        err_min:  20.867, err max: 100.000
     cond #   0.1230E-01,     cpu Analysis:  0.052

 Level:    2, Nb_ana_points:  3240, Nb_data:   263
              Nb_ovsamp:     89,  fact_mult:    1.00, fact_mult2:    1.00
     ano_max:  14.609, inov min:  -3.551, inov max:   0.841
                       fld  min:  -1.720, fld  max:   0.007
                        err_min:  21.434, err max: 100.000
     cond #   0.1092E-01,     cpu Analysis:  0.048

 Level:    3, Nb_ana_points:  3240, Nb_data:   263
              Nb_ovsamp:     89,  fact_mult:    1.00, fact_mult2:    1.00
     ano_max:  13.727, inov min:  -3.563, inov max:   0.830
                       fld  min:  -1.742, fld  max:   0.006
                        err_min:  21.487, err max: 100.000
     cond #   0.1237E-01,     cpu Analysis:  0.044
...
...

   *****   End area:
     err_min_tot:  20.867, err max_tot: 100.000
  cpu total area :    0.380
  ********************
```

8.5. log file of the post-processing steps

```
 >>>>>>>  Running ISAS_V6/POSTOA ,  15-Nov-2011 10:02:05


 ARGLV6NRT PSAL  20110115
 dir_oaf90_tmp : /net/caparmor-
nas/mnt/data2/home1/fgaillar/OARUN/arglv6NRT/data/2011/PSAL/
 dir_OA_field  :
/net/luarca/export/home1/analysis_NRT/arglv6NRT/ISAS_RESU/field/2011
 dir_OA_data   :
/net/luarca/export/home1/analysis_NRT/arglv6NRT/ISAS_RESU/data/2011
 dir_clim      :
/home5/garo/arivo/software/isas/isas_ana/confstd_v5c3/climref/
 AREA_LIMITS:   -81.00    90.00  -180.00   180.00
```

```
 filter_err_max =   80,  AMPL_OA = 41.0

Area  504 missing on remote computer
Area  505 missing on remote computer
Area  506 missing on remote computer
  >>>> Copy terminated in 105.067581 sec, 176 area found

 Number of OA data: 27136

Ok: NCW_data_hdr
Ok: NCW_data_var
 >>>> Processing time for data: 15.35

 ... Processing time for field anomaly: 55.92
 ... Processing time for smoothing: 347.15
 ... Processing time for absolute field: 76.18
```