

Collocation and validation tools for the DRAKKAR ensemble of simulations

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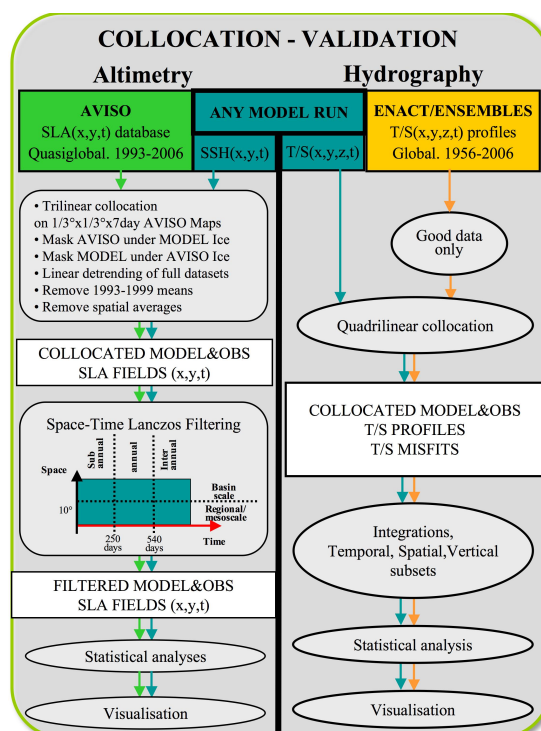
Novembre 2011

This document describes a set of programs used for the validation of DRAKKAR model outputs. The simulations are evaluated against hydrographic observations (temperature/salinity profiles from ENSEMBLES/ENACT), altimetric products (gridded sea level anomalies from AVISO), sea surface temperature (Reynolds reanalysis) and currentmeters data .

First, the model outputs are sub-sampled like actual observations to build synthetic data. Then, real and "synthetic" observations and more integral quantities (mixed layer depth, heat and salt contents) are compared over various regions, periods and timescales.

The programs are sorted by category : ENSEMBLES/ENACT (evaluation with T/S profiles), AVISO (evaluation with SLA satellite products), NOAA (evaluation with SST reanalysis), CURRENT METERS (evaluation with U/V timeseries) and MODEL (treatment of model outputs before collocation or for comparing collocated with full model outputs). Most calculation programs are written in Fortran 90, others in Matlab. Ocean Data View, Chart and Matlab are used for the visualisation.

We note the use of tools developed in the MEOM research team (LEGI, Grenoble) : CDF-TOOLS (J.M. Molines), cdfop (J.M. Brankart) and SESAM (J.M. Brankart, C.E. testut and L. Parent).



Programs

- .f90 = fortran90,
- .m = matlab,

- .csh = interactive script on local machine,
- .ll = script ready for batch submission on vargas (IDRIS),
- .psb = script ready for batch submission on jade (CINES).

Rq : change in IDRIS : work with script in multistep now...

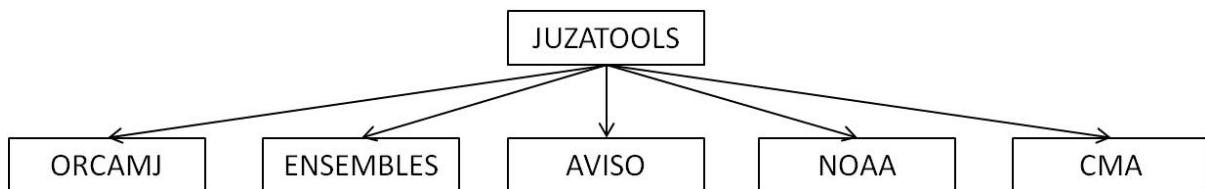
Compilation procedure

- vi Makefile : compilation lines
- ln -s make.yourmachine make.macro : link to the paths
- make : compilation

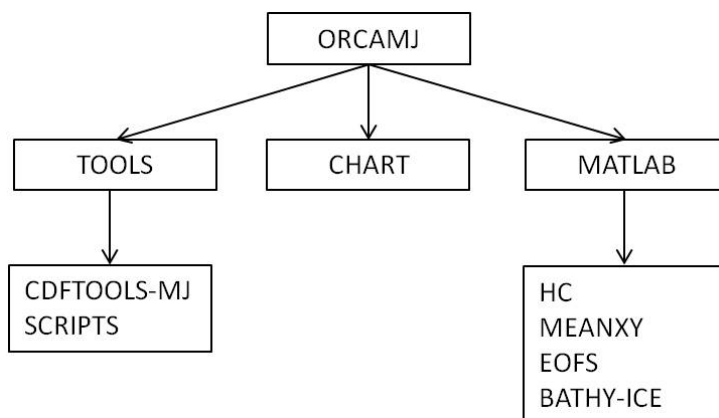
Version control system : SVN

The following programs have been saved in the version control system, SVN. Informations and sources are available at <https://servforge.legi.grenoble-inp.fr/projects/JUZATOOLS>

Architecture



1 MODEL



1.1 CDFTOOLS

1.1.1 CDFTOOLS (J.M. Molines)

cdfmoy

Purpose : product monthly climatology of DRAKKAR model : monthly means over annual and interannual period of DRAKKAR files.

Associated routine : cd fio.f90.

Associated script : cdfmoy_modif.ll, cdfmoy-inter_modif.ll, cdfmoy-inter_EKE.ll, cdfmoy-inter_gridUV.ll, cdfmoy_mensT_ORCA2.ll (for ORCA2), cdfmoy_HCSC_MLD.ll

cdfmean

Purpose : compute the global spatial mean of SSH of DRAKKAR model outputs.

Associated routine : cd fio.f90.

Associated script : cdfmean_SSH.ll

cdfinreg

Purpose : compute the linear trend of model data (gridT, HC-bathy,...)

Inputs : annual means

Associated routine : cd fio.f90.

Associated script : cdfinreg(_HC).ll

cdfstd

Purpose : compute the standard deviation of model heat heat

Associated routine : cd fio.f90.

Associated script : cdfstd_clim.ll, cdfstd_annual.ll, cdfstd_annual_detrend.ll

cdfpsi

Purpose : compute the Barotropic Stream Function

Associated routine : cd fio.f90.

Associated script : calcul_psi.ll

cdsmooth

Purpose : filtering using Lanczos filter

Associated routine : cdfio.f90.

Associated script : cdsmooth.psb

1.1.2 CDFTOOLS-MJ

The work with DRAKKAR model outputs made me to develop some programs, which will be included in the CDFTOOLS.

repli(_mel).f90

Purpose : Unfold the northern part of an Orca domain and put the whole Arctic north of Atlantic and Pacific

Associated script : extract_ice_arctic.csh

cdfconvert_gridT.f90

Purpose : convert a set of dimgfile (Clipper like) to a set of CDF files (Drakkar like).

Associated scripts : convertBABY15.ll, convertNATL3.ll

cdfmltmask.f90

Purpose : mask of perpetual Levitus file (monthly means) + group T and S in the same file.

Inputs : ORCA2 : Levitus file containing the 12 monthly means which are not masked on ORCA2 grid. ORCA025 : monthly Levitus files which are not masked on ORCA025 grid.

Outputs : monthly masked Levitus files.

Usage : cdfmltmask.x input.nc mask.nc votemper/vosaline T

Associated routine : cdfio.f90.

Associated script : mask_levitus_mens_orca2.ll, mask_levitus_mens_orca025.ll.

cdfslope.f90

Purpose : compute the simulated bottom depth, the zonal and meridional slopes (on gridT, gridU and gridV, respectively).

Inputs : model vertical and horizontal mesh file.

Output : simulated bottom depth, the zonal and meridional slopes file.

Usage : cdfslope.x coordzgr.nc coordhgr.nc

Associated routine : cdfio.f90.

Associated script : script_slope.ll

cdfmxlhcsc.f90

Purpose : compute the MLD (possibility of 3 criteria) and the HC/SC within the MLD at global scale.

Input : OPA file (grid T) (each 5 days).

Usage : cdfmxlhsc.x input.nc type_criterion val_criterion

Associated routines : cdfio.f90, eos.f90.

Associated script : calcul_HCSC_MLD_opa_files.ll.

Concatenations : concat_HCSC_MLD_OPA_month.csh (into file containing the same month over a period), concat_HCSC_MLD_OPA_saison.csh (into seasonal files over a year and pentades).

Zoom : zoom over a region from lon, lat (zoom_ HCSC_MLD_opa_files.ll)

cdfmxlhsc_hmin.f90

Purpose : compute the MLD (possibility of 3 criteria) and the HC/SC integrated between hmin and MLD .

Input : OPA file (grid T) (each 5 days).

Usage : cdfmxlhsc_hmin.x input.nc type_criterion val_criterion hmin

Associated routines : cdfio.f90, eos.f90.

Associated script : calcul_HCSC_MLD_hmin_opa_files.ll, calcul_HCSC_MLD_hmin_opa(mask)_files.psb

Concatenations : concat_HCSC_MLD_hmin_OPA_month(/_season/month_zoom).ll,
concat_HCSC_MLD_hmin_OPA(/opamask)_month.psb

Zoom : zoom over a region from lon, lat (zoom_ HCSC_MLD_hmin_opa_files.ll), zoom over a region in the ij index ORCA space (zoom_ij_ HCSC_MLD_hmin_opa_files.ll, zoom_ij_ HCSC_MLD_hmin_opa_files_mask.psb)

cdfhcsc.f90

Purpose : compute the heat and salt contents between hmin and hmax (depths in meters).

Input : OPA file (grid T) (each 5 days).

Usage : cdfhcsc.x input.nc hmin hmax

Associated routines : cdfio.f90

Associated script : calcul_HCSC_opa_files.ll

Concatenations : concat_HCSC_OPA_month.ll

Zoom : zoom over a region from lon, lat (zoom_ HCSC_MLD_opa_files.ll)

cdfhc.90

Purpose : compute the heat content hmin and hmax (depths in meters).

Input : OPA file (grid T) (each 5 days).

Usage : cdfhc.x input.nc hmin hmax

Associated routines : cdfio.f90

Associated script : (multistep_)calcul_HC_opa_clim_files.ll,)calcul_HC_opa_clim_files.psb, (multistep_)calcul_HC_opa_annual_files.ll

cdfhcbathy.f90

Purpose : compute the heat content within all the water column (from the surface to the bottom)

Usage : cdfhcbathy.x hc-file.nc bathy-file.nc

Associated routines : cdfio.f90

Associated script : calcul_HC_bathy_opa_files.ll

cdfhcbathy_hmin.f90

Purpose : compute the heat content between hmin and the bottom (topography)

Usage : cdfhcbathy_hmin.x hc-file.nc bathy-file.nc

Associated routines : cdfio.f90

Associated script : (multistep_)calcul_HC_bathy_hmin_opa(_clim/_annual)_files.ll

cdfmask_hc_bathy.f90

detrend_HC(monthly).f90

distrib_HC_bathy(_inv).f90

cdfmask_mxlhsc.f90

modif_ssh_OPA_files.f90

Purpose : modification of OPA files such as we keep only the variable SSH and SSH(ice>0.05)
= missing value.

Input : OPA file (grid T, SSH) (each 5 days).

Output : OPA file which contains only SSH (without ice).

Usage : modif_ssh_OPA_files.x filein.nc fileout.nc

Associated routine : cdfio.f90.

Associated script : (multistep_)modif_ssh_opa_files.ll, modif_ssh_opa_files_filt.psb,
modif_ssh_opa_ORCA025-MJM01_files.ll

modif_ORCA025-MJM_files.ll,modif_ORCA025-MJM_files_month.ll,modif_ORCA1_files.ll

modif_ssh_opa_ORCA025-MJM01_files.ll

Associated script : multistep_ice_frequency_opa_files.ll, ice_frequency_opa_files.psb

calcul_intensity_windstress.f90

ice_frequency_OPA_files.f90

mask_ice_sw_OPA_files.x

Purpose : mask T/S where Shallow water and Ice.

Associated script : mask_ice-and-sw_opa_files_TS.psb

1.1.3 Others useful scripts

modif_ORCA1_files.ll : modification of ORCA1 files : one file = one snapshot.

modif_ORCA025-MJM_(.month)files.ll

script_dates.ll : creation of ASCII file containing the DRAKKAR calendar dates over a period.

multistep_concat_opa_files.ll

deconcat_sst_opa_ORCA025-MJM01_files.ll

1.2 Visualisation

1.2.1 Global map (ORCAMJ/CHART)

fig_EKE.csh(.local) : plot model EKE.

fig_flux(.new).csh.local

fig_std_HC.csh, fig_std-HC_bathy.csh, fig_pour_std_HC.csh

anim_MLD.csh : animation of model MLD.

1.2.2 Global Heat Content (ORCAMJ/MATLAB/HC)

fig_stdHC(_new).m

fig_stdHC_2layers(_new).m

fig_distrib_HC-bathy_inv.m

1.2.3 Time series of MSSH (ORCAMJ/MATLAB/MEANXY/)

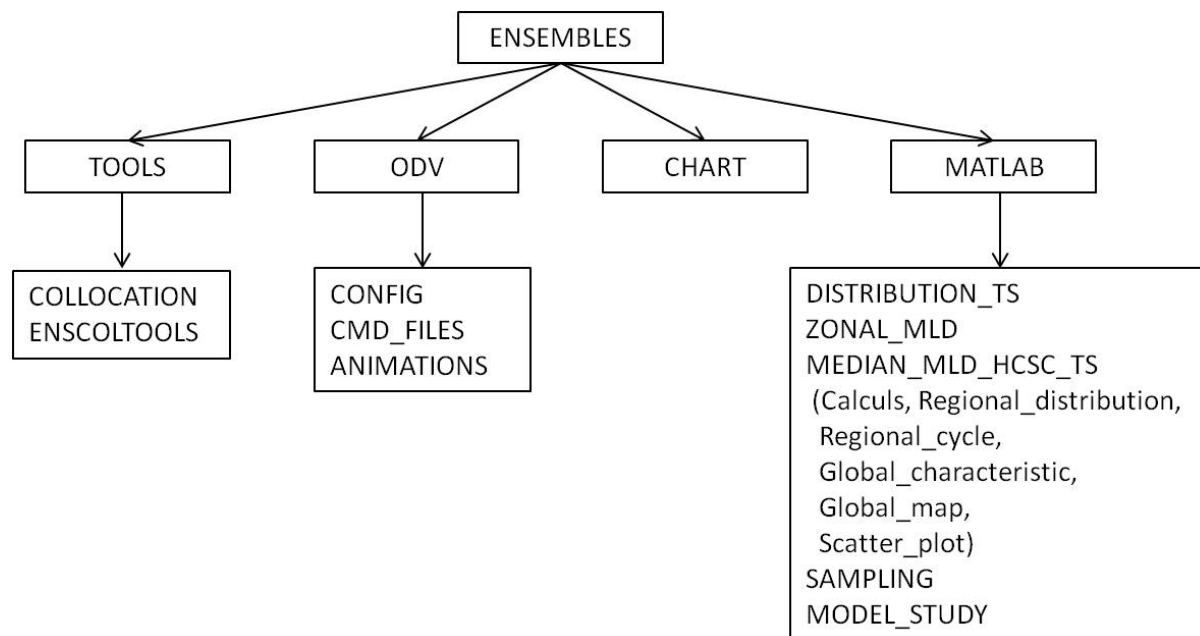
SSH_meanxy.m : timeserie of the spatial mean simulated SSH.

1.2.4 EOFs (ORCAMJ/MATLAB/EOFS/)

apleof_BSF_NAOweek_Xrun(_corsig/_corsiglag).m

2 ENSEMBLES/ENACT

The ENSEMBLES/ENACT (european project) database includes hydrographic observations (T/S profiles) collected throughout the global ocean, most by moored buoys (TRITON, PIRATA, TAO...), thermograpgh (XBT), ship T/S profils (CTD), ARGO profiling floats, etc... The data are available from 1956 to present and in a NetCDF format. For details, see the website : <http://www.hadobs.org/>.



2.1 Collocation MODEL-OBS (ENSEMBLES/TOOLS/COLLOCATION/)

The following programs are available in ENSTOOLS.tar.

The script `script_modif_nomenclature.ll` adapts the nomenclature files to the program...

opa2ens(_new).f90

Purpose : spatio-temporal (4D) collocation of DRAKKAR simulated T/S on observed T/S profiles.

Inputs : OPA files (each 5-day means) and ENSEMBLES/ENACT profiles merged in monthly files.

Outputs : collocated simulated and observed T/S profiles merged in monthly files.

Rq : the new version makes the dimension NPROF unlimited.

Usage : `opa2ens(_new).x < namelist.txt` (nomenclatures of input and output files, dates of OPA files, dates of the beginning and the end of ENS files, periodicity of the ORCA grid).

Associated routines : `cdfio.f90` (CDFTOOLS), `mod_opa.f90`, `mod_ens.f90`, `mod_math.f90`.

Associated script : `script_loc_ens(_new).ll`, `multistep_loc_ens(_new).ll`, `script_loc_ens_new.psb`

Concatenation : `script_concat_annual.csh` (monthly files into annual files).

opam2ens.f90

Purpose : spatio-temporal (4D) collocation of Levitus or DRAKKAR model climatology on observed T/S profiles.

Inputs : files of monthly means on grid ORCA (dated to the 15 of each month) and ENSEMBLES/ENACT profiles merged in monthly files.

Outputs : collocated simulated and Levitus observed T/S.

Usage : opam2ens.x < namelist.txt (nomenclatures of input and output files, dates of OPA files, dates of the beginning and the end of ENS files, periodicity of the ORCA grid).

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_ens.f90, mod_math.f90.

Associated script : script_loc_ens_LEV.ll (climatology of Levitus), script_loc_ens_CLIMopa.ll (climatology of the model).

opa2ens_reg.f90

Purpose : spatio-temporal (4D) collocation of regional simulated T/S (BABY15, GASC15) on observed T/S profiles.

Inputs : regional (BABY15, GASC15) OPA files (each 5-day means) and ENSEMBLES/ENACT profiles merged in monthly files.

Outputs : collocated simulated and observed T/S profiles merged in monthly files.

Usage : opa2ens_reg.x < namelist.txt (nomenclatures of input and output files, dates of OPA files, dates of the beginning and the end of ENS files, periodicity of the ORCA grid).

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_ens.f90, mod_math.f90.

Associated script : script_loc_ens_BABY15-GASC15.ll

Concatenation : script_concat_annual.csh (monthly files into annual files).

opa2ens_bathy.f90

Purpose : spatial (2D) collocation of the simulated bathymetry on the observed T/S profiles.

Inputs : OPA bathymetry file and ENSEMBLES/ENACT profiles merged in monthly files.

Outputs : collocated simulated bathymetry file.

Usage : opa2ens_bathy.x < namelist.txt (nomenclatures of input and output files, periodicity of the ORCA grid).

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_ens.f90, mod_math.f90.

Associated script : script_loc_ens_bathy.ll, multistep_loc_ens_bathy.ll

opa2ens_ssh.f90

Purpose : spatial (2D) and temporal collocation of the simulated SSH on the observed T/S profiles.

Inputs : OPA SSH file and ENSEMBLES/ENACT profiles merged in monthly files.

Outputs : collocated simulated SSH file.

Usage : opa2ens_ssh.x < namelist.txt (nomenclatures of input and output files, periodicity of the ORCA grid).

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_ens.f90, mod_math.f90.

Associated script : multistep_loc_ens_ssh.ll

opa2ens_bsf.f90

Purpose : idem for BSF

Associated script : multistep_loc_ens_bsf.ll

opa2ens_ileadfra

Purpose : idem for ice concentration

Associated script : multistep_loc_ens_ileadfra.ll

2.2 Post-processing of the collocated data (ENSEMBLES/TOOLS/ENSCOLTOOLS/)

2.2.1 Integrated quantities

calcul_HCSC.f90

Purpose : compute the heat and salt contents between hmin and hmax of the collocated simulated and observed T/S files.

Input : monthly file of collocated simulated and observed T/S.

Output : monthly file of collocated simulated and observed HC/SC.

Usage : calcul_HCSC.x input.nc hmin hmax dhmax

Associated routine : mod_enscol.f90

Associated script : script_calcul_HCSC.ll/.csh, multistep_calcul_HCSC(_zone).ll

Concatenations : script_concat_HCSC_annual.csh (monthly files into annual file),
concat_HCSC_period.csh (into interannual file).

calcul_HCSC_TS.f90

Purpose : compute the heat and salt contents, and the temperature and salinity between hmin and hmax of the collocated simulated and observed T/S files.

Input : monthly file of collocated simulated and observed T/S.

Output : monthly file of collocated simulated and observed HC/SC and integrated T/S.

Usage : calcul_HCSC_TS.x input.nc hmin hmax dhmax

Associated routine : mod_enscol.f90

Associated script : script_calcul_HCSC_TS.ll/.csh

Concatenations : script_concat_HCSC_TS_month_period.ll (monthly files into file containing the same month over an interannual period).

calcul_MLD.f90

Purpose : compute the Mixed Layer Depth according to a criterion of temperature or density.

Input : monthly file of collocated simulated and observed T/S or of collocated climatology (Levitus or model)/ENSEMBLES files.

Output : monthly file of simulated and observed MLD.

Usage : calcul_MLD.x input.nc type_criterion val_criterion surf_ref_depth

Associated routines : mod_enscol.f90 dens1d.f90

Associated script : script_calcul_MLD.ll/.csh or script_calcul_MLD_clim.ll,
multistep_calcul_MLD.ll

Concatenations : script_concat_MLD_month_period.csh (monthly files into file containing the same month over an interannual period), script_concat_MLD_saison.csh (monthly files into seasonal file over year and pentades).

calcul_HCSC_mld.f90

Purpose : compute the heat and salt contents between hmin and MLD.

Input : collocated simulated and observed T/S monthly file, and associated MLD file, computed before.

Output : monthly file of simulated and observed HC/SC(mld)

Usage : calcul_HCSC_mld.x input1.nc input2.nc

Associated routine : mod_enscol.f90

Associated script : script_calcul_HCSC_mld.csh

Concatenations : script_concat_HCSC_mld_month_period.csh (monthly files into file containing the same month over an interannual period),
script_concat_HCSC_mld_annual.csh (monthly files into annual file),
script_concat_HCSC_mld_saison.csh (monthly files into seasonal file over a year),
script_concat_HCSC_mld_saison_pentade.csh (seasonal files a year into seasonal files over pentades).

calcul_HCSC_TS_mld.f90

Purpose : compute the heat and salt contents, temperature and salinity integrated between hmin and MLD.

Input : collocated simulated and observed T/S monthly file, and associated MLD file.

Output : monthly file of simulated and observed HC/SC(mld).

Usage : calcul_HCSC_TS_mld.x input1.nc input2.nc hmin dhmax

Associated routine : mod_enscol.f90

Associated script : scrip_calcul_HCSC_TS_mld.ll, multistep_calcul_HCSC_TS_mld.ll,
scrip_calcul_HCSC_TS_mld_clim.ll (for collocated climatology (Levitus or model) / ENSEMBLES files).

Concatenations : script_concat_HCSC_TS_mld_month_period.ll,
script_concat_HCSC_TS_mld_month_period_climll (monthly files into file containing the same month over an interannual period),
script_concat_saison_period.ll, script_concat_HCSC_TS_mld_saison_clim.ll,
script_concat_HCSC_TS_mld_saison_pentades_clim.ll (monthly files into seasonal file over a period and into interannual over this period).

calcul_isoT.f90,calcul_isopycn.f90

Purpose : compute the deptht corresponding to an isotherm or isopycn given in argument.

Input : monthly file of collocated simulated and observed T/S profiles.

Output : monthly file of isotherm or isopycn.

Usage : calcul_isoT(isopycn).x input.nc val

Associated routines : mod_enscol.f90,dens1d.f90

Associated script : script_calcul_ISO.csh

Concatenation : script_concat_ISO_month_period.csh (monthly files into files containing the same month over a interannual period).

calcul_depth_and_tmean_isoT.f90

Purpose : compute the depth corresponding to an isotherm given in argument and the mean temperature above this isotherm depth.

Input : monthly file of collocated simulated and observed T/S profiles.

Output : monthly file of depth and mean temperature

Usage : calcul_depth_and_tmean_isoT.x input.nc val

Associated routines : mod_enscol.f90

Associated script : multistep_calcul_depth_and_tmean_isoT(_zone).ll

2.2.2 Extraction of ARGO floats

extract_ARGO.f90

Purpose : extraction of ARGO profiles from monthly T/S collocated MODEL/ENSEMBLES files.

Input : monthly file of collocated simulated and observed T/S.

Output : monthly file of collocated simulated and observed (only ARGO floats) T/S.

Usage : extract_ARGO.x input.nc

Associated routine : mod_enscol.f90

Associated script : script_extract_ARGO.ll/.csh, multistep_extract_ARGO.ll

Concatenation : script_concat_ARGO_period.csh (into annual and interannual files)

extract_ARGO_HCSC.f90

Purpose : extraction of ARGO profiles from monthly HCSC collocated MODEL/ENSEMBLES files.

Input : monthly file of collocated simulated and observed HC/SC.

Output : monthly file of collocated simulated and observed (only ARGO floats) HC/SC.

Usage : extract_ARGO_HCSC.x input.nc

Associated routine : mod_enscol_HCSC.f90

Associated script : script_extract_ARGO_HCSC.csh

Concatenation : script_concat_HCSC_ARGO_period.csh (into annual and interannual files).

extract_ARGO_MLD.f90

Purpose : extraction of ARGO profiles from monthly MLD collocated MODEL/ENSEMBLES files.

Input : monthly file of collocated simulated and observed MLD.

Output : monthly file of collocated simulated and observed (only ARGO floats) MLD.

Usage : extract_ARGO_MLD.x input.nc

Associated routine : mod_enscol.f90

Associated script : script_extract_ARGO_MLD.csh/.ll

Concatenation : script_concat_MLD_month_period_ARGO.csh/.ll (over period).

extract_ARGO_HCSCmld.f90

Purpose : extraction of ARGO profiles from monthly HC/SC(mld) collocated MODEL/ENSEMBLES files.

Input : monthly file of collocated simulated and observed HC/SC within MLD.

Output : monthly file of collocated simulated and observed (only ARGO floats) HC/SC within MLD.

Usage : extract_ARGO_HCSCmld.x input.nc

Associated routine : mod_enscol_MLD_HCSC.f90

Associated script : script_extract_ARGO_HCSCmld.csh

Concatenation : script_concat_HCSCmld_ARGO_period.csh

Remarque : to simplify we can merge the 4 scripts into 1 (for that put the output of the program.x = output.nc).

2.2.3 Statistical quantities

cutgrid025 = cut using the ORCA025 grid.

pdfstat_HCSC_TS_ORCA.f90

Purpose : monthly or interannual analysis : plot median and percentiles 17% and 83% of the PDF of monthly (merged over an interannual period) or seasonal HC,SC,T,S (integrated within a constant layer) as a function of months or years, at global scale. For the full model, the collocated model,the observations and the model bias (model-obs).

Inputs : OPA model HC/SC files [input1.nc], collocated simulated and observed HC/SC,T/S file (monthly files merged over a period or seasonal (by year) files) [input2.nc], depths determining the layer of integration [hmin, hmax], type of instrument (ARGO, BATHY, TESAC, BUOY or ALL) [inst], model grid (ORCA025 or ORCA05 only) [grid].

Outputs : PDFhmin-hmax_EN3_v1c_ORCA025-G70_month_1998-2004_inst_comp/col/obs/bias/pos.txt or PDFhmin-hmax_EN3_v1c_ORCA025-G70_season_YEAR_inst_comp/col/obs/bias/pos.txt.

Usage : pdfstat_MLD_HCSC_TS_ORCA.x input1.nc input2.nc hmin hmax inst grid < namelist.txt

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa_HCSC.f90, mod_enscol_HCSC_TS.

Associated script : script_pdfmens_bis.ll, script_pdfseason_bias.ll.

pdfstat_MLD_HCSC_TS_ORCA.f90

Purpose : monthly or interannual analysis : plot median and percentiles 17% and 83% of the PDF of monthly (merged over an interannual period) or seasonal MLD,HC,SC,T,S as a function of months or years, at global scale. For the full model, the collocated model,the observations and the model bias (model-obs).

Inputs : OPA model HC/SC(mld) files [input1.nc], collocated simulated and observed HC/SC,T/S(mld) file (monthly files merged over a period or seasonal (by year) files) [input2.nc], reference surface for the calculation of MLD [zsurf], type of instrument (ARGO, BATHY, TESAC, BUOY or ALL) [inst], model grid (ORCA025 or ORCA05 only) [grid].

Outputs : PDFmldT02_EN3_v1c_ORCA025-G70_month_1998-2004_inst_comp/col/obs/bias/pos.txt or PDFmldT02_EN3_v1c_ORCA025-G70_season_YEAR_inst_comp/col/obs/bias/pos.txt.

Usage : pdfstat_MLD_HCSC_TS_ORCA.x input1.nc input2.nc zsurf inst grid < namelist.txt

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa_MLD_HCSC.f90, mod_enscol_MLD_HCSC_TS.

Associated script : script_pdfmens.ll, script_pdfmens_gen.ll, script_pdfseason.ll.

pdfstat_MLD_HCSC_TS_ORCA_T(S)_new.f90

Associated script : script_pdfmens_T(S)_new(_mask).ll

pdfstat_MLD_HCSC_TS_ORCA_bias(_new/_Tnew).f90

Purpose : the same as pdfstat_MLD_HCSC_TS_ORCA.f90 but only for the model bias.

Outputs : *bias/pos.txt only.

Associated script : script_pdfmens_bias(_new/_Tnew_T/_cutgrid025_new).ll, script_pdfseason_bias.ll.

pdfstat_MLD_HCSC_TS_ORCA_bias_col_obs_T(S)_new.f90

Associated script : script_pdfmens_bias_col_obsT(S)_cutgrid025_new.ll

pdfstat_MLD_HCSC_TS_ORCA_withoutINST.f90

Associated script : script_pdfmens_withoutinst(_cutgrid025).ll

pdfstat_MLD_HCSC_TS_ORCA_x4(xi05).f90

Associated script : script_pdfmens_x4.ll

pdfstd_MLD_HCSC_TS_ORCA.f90

Purpose : monthly or interannual analysis : calculation of the standard deviation of the monthly (merged over an interannual period) or seasonal MLD,HC,SC,T,S distributions, as a function of months or years, at global scale. For the full model, the collocated model and the observations.

Inputs : OPA model HC/SC(mld) files [input1.nc], collocated simulated and observed HC/SC,T/S(mld) file (monthly files merged over a period or seasonal (by year) files) [input2.nc], reference surface for the calculation of MLD [zsurf], type of instrument (ARGO, BATHY, TESAC, BUOY or ALL) [inst], model grid (ORCA025 or ORCA05 only) [grid].

Outputs : std_PDFmldT02_EN3_v1c_ORCA025-G70fo_month_2002-2006_inst_comp.txt

Usage : pdfstd_MLD_HCSC_TS_ORCA.x input1.nc input2.nc zsurf inst grid < namelist.txt

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa_MLD_HCSC.f90, mod_enscol_MLD_HCSC_TS.

pdfmean_MLD_HCSC_TS_ORCA.f90

Associated script : script_pdfmens_mean.ll

2.2.4 Distribution of profiles in the model space

posARGOonORCA.f90

Purpose : localization of ARGO profiles in the i,j model space (global or regional) .

Input : collocated ENSEMBLES/model file (coloc_file.nc), file of model grid (mesh_hgr.nc).

Outputs : ASCII file containing longitude and latitude of the profiles inside the region (posARGOT*.txt=where T(mld) has been computed, posARGOS*.txt=where S(mld) has been computed).

Usage : posARGOonORCA.x coloc_file.nc mesh_hgr.nc imin imax jmin jmax

Associated routine : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_enscol_MLD_HCSC_TS.f90.

Associated script : script_posARGOonORCA.ll

posPROFonORCA.f90

Purpose : generalization of posARGOonORCA.f90 (profiles coming from selected instrument).

Outputs : posPROFT*.txt, posPROFS*.txt.

Associated script : script_posPROFonORCA(_mask).ll

2.2.5 Extraction of a selected region

extract_zone(_new).f90

Purpose : extraction of profiles inside a selected region.

Input : collocated ENSEMBLES/model file (input.nc), minimal and maximal longitudes and latitudes of the region for extraction.

Output : zone_file.nc

Usage : extract_zone(_new).x input.nc lonmin lonmax latmin latmax

Associated routine : mod_enscol.f90.

Associated script : script_extract_zone.ll, multistep_extract_zone.ll

extract_contour(_pac).f90

Purpose : extraction of profiles inside a selected contour : Atlantic, Indian (extract_contour.f90), Pacific (extract_contour_pac).

Input : collocated ENSEMBLES/model file (input.nc) and ASCII file of contour (contour.txt).

Output : zone_file.nc

Usage : extract_contour(_pac).x input.nc contour.txt

Associated routine : mod_enscol.f90.

Associated script : multistep_extract_contour.ll

2.2.6 Autres

modif_dim.f90

Purpose : the actual dimension N.LEV=150; when this is not the case (corrupted file), the program makes the dimension N.LEV=150, completing by missing values.

2.3 Visualisation

2.3.1 Global map of integrated quantities (ENSEMBLES/ODV/)

Ocean Data View a software package for the interactive exploration, analysis and visualization of oceanographic and other geo-referenced profil or sequence data. Here, we use it for the visualization of surface data (heat and salt contents, mixed layer depth...) at global scale.

For details, see the website : <http://odv.awi.de/>.

The following programs are available in ENSODV.tar.

HC(SC)_config.cfg

Purpose : plot collocated observed and simulated HC(SC), the difference and the relative misfit of HC(SC).

Input : collocated model/ENSEMBLES HCSC file.

Associated script : anim_HCSC.csh (HCSC.cmd, HC(SC)_config.cfg), fig_HCSC_period.csh (HCSC_period.cmd, HC(SC)_config.cfg).

HC(SC)_config_ARGO.cfg

Purpose : plot observed HC and SC and the difference between collocated observed and simulated HC and SC.

Input : collocated model/ENSEMBLES HCSC file where ARGO floats have been extracted.

HCSC_ARGO_config.cfg

HCobs_global_config.xview

HCSCobs_diff_config.cfg

Purpose : plot observed HC and SC and the difference between collocated observed and simulated HC and SC.

Input : collocated model/ENSEMBLES HCSC file.

HCSC_zone_config.cfg (zone=global,NATL,austral,indien,pac.eq)

Purpose : plot the difference between collocated observed and simulated HC and SC.

Input : collocated model/ENSEMBLES HCSC file.

Associated script : anim_HCSC_pentades.csh (HCSC_pentades.cmd, HCSC_zone_config.cfg).

HCSC_global_config.xview

mld_config.cfg

Purpose : plot collocated observed and simulated MLD, the difference and the relative misfit of MLD.

Input : collocated model/ENSEMBLES MLD file (all profiles or ARGO floats only).

Associated script : anim_MLD.csh (MLD.cmd, mld_config.cfg),
anim_MLD_ARGO.csh (MLD_ARGO.cmd, mld_config.cfg).

mld_config_2.cfg

Purpose : plot collocated observed and simulated MLD.

Input : collocated model/ENSEMBLES MLD file.

Associated script : replace MLD_ARGO.cmd by MLD_ARGO_2.cmd in anim_MLD_ARGO.csh.

mld-from-HCSC-TS_config(_2/_3).cfg(.xview)

mld_config_new.xview

HC(SC)mld_config.cfg

Purpose : plot collocated observed and simulated HC(SC) integrated within the MLD, the difference and the relative misfit of these HC(SC).

Input : collocated model/ENSEMBLES HCSC within the MLD file.

Associated script : anim_HCSC_mld_month.csh (HCSC_mld_month.cmd, HC(SC)mld_config.cfg)

HCmld_config_winter.cfg/SCmld_config_winter.cfg

Purpose : plot collocated observed and simulated HC(SC) integrated within the MLD, the difference and the relative misfit of these HC(SC).

Input : collocated model/ENSEMBLES HCSC within the MLD file.

Associated script : anim_HCSC_mld_saison.csh (HCSC_mld_saison.cmd, HC(SC)mld_config_winter.cfg)

HCSC_TS_mld_config.cfg

Purpose : plot the HC(mld), SC(mld), T(mld) and S(mld) differences between the collocated observations and simulations.

Input : collocated model/ENSEMBLES T/S/HC/SC within the MLD file.

diff_TS_mld_config.cfg

Purpose : plot the T(mld) and S(mld) differences between the collocated observations and simulations.

Input : collocated model/ENSEMBLES T/S/HC/SC within the MLD file.

Associated script : anim_HCSC_TS_mld_saison_period.csh (TS_mld_saison.cmd, diff_TS_mld_config.cfg).

isoT_config.cfg(.xview)/isopycn_config.cfg

Purpose : plot collocated observed and simulated isotherm/isopycn.

Input : collocated model/ENSEMBLES isotherm/isopycn file.

Associated script : anim_iso.csh (ISO.cmd, isoT_config.cfg/isopycn_config.cfg).

instrument.xview

2.3.2 Section of hydrographic profiles (ENSEMBLES/OVD/)

T_sectionA23.cfg/S_sectionA23.cfg

Purpose : plot the collocated observed and simulated T/S at the section A23 as a function of latitude(x) and depth(y).

Input : collocated model/ENSEMBLES files where the region around the section A23 has been extracted.

Associated file : sectionA23.sec

sectionA8_april1994_200m_S.cfg

Associated file : sectionA8_april1994.sec

sectionA9_february(march)1991(_200m/_200m_S/_1000m).cfg

Associated file : sectionA9_march1991.sec

2.3.3 Distributions (ENSEMBLES/MATLAB/DISTRIBUTION_TS)

reg = regional ; med = median ; lon = f(longitude) ; lat = f(latitude)

distrib_TS_2runs.m

Purpose : plot the distributions of the global or regional T/S biases for all profiles or ARGO floats only.

Input : collocated simulated and observed HC/SC merged into annual file.

2 cases : files containing all profiles and files where ARGO floats has been extracted.

Output : plots (jpg,ps).

distrib_misfits_TS.m

Purpose : plot the distributions of T/S bias as a function of depth at global scale for all profiles or ARGO floats only.

Input : collocated simulated and observed T/S merged into annual collocated files.

3 cases : files containing all profiles at global and regional (BABY15/GASC15) scales, and files where ARGO floats has been extracted.

Output : plots (jpg,ps).

distrib-med_misfits_TS_Xruns(_reg).m

Purpose : plot the median of the distributions of T/S bias as a function of depth for X simulations.

Input : collocated simulated and observed T/S merged into annual collocated files.

Output : plots (jpg,ps).

distrib_misfits_T_reg.m, distrib_misfits_S_reg.m, fig_distrib_misfits_TS_reg.m

- idem over a selected region.
- adapted to full files or files where ARGO floats has been extracted.
- separate programs for T and S because of too long time of calculation...

distrib_HCSC.m

Purpose : plot the distributions of the global or regional HC/SC biases for all profiles or ARGO floats only.

Input : collocated simulated and observed HC/SC merged into annual file.

2 cases : files containing all profiles and files where ARGO floats has been extracted.

Output : plots (jpg,ps).

distrib_lon_lat_HCSC_zone.m

Purpose : plot the distributions of HC/SC bias as a function of latitude and as a function of longitude at global or regional scale.

Input : collocated simulated and observed HC/SC merged over a selected period.

Output : plots (jpg,ps).

distrib-med_lon_lat_HCSC_zone_4runs.m, medians_lon_lat_HCSC_zone_4runs.m

Purpose : plot the median of the distributions of HC/SC bias as a function of latitude and as a function of longitude at global or regional scale for 4 simulations.

Input : collocated simulated and observed HC/SC merged over a selected period.

Output : plots (jpg,ps).

distrib-med_lat_HCSC_zone_Xruns_new.m, medians_lat_HCSC_zone_Xruns.m

Purpose : plot the median of the distributions of HC/SC bias as a function of latitude.

Input : collocated simulated and observed HC/SC merged over a selected period.

Output : plots (jpg,ps).

distrib-med_lon_HCSC_zone_Xruns_new.m

Purpose : plot the median of the distributions of HC/SC bias as a function of longitude.

Input : collocated simulated and observed HC/SC merged over a selected period.

Output : plots (jpg,ps).

distrib-med_lat_isoT_zone_Xruns_new.m

Purpose : plot the median of the distributions of isotherm bias as a function of latitude.

Input : collocated simulated and observed isotherms merged over a selected period.

Output : plots (jpg,ps).

distrib-med_TSD_4runs.m

Purpose : plot the median of the distributions of temperature, salinity, density as a function of depth.

Input : collocated simulated and observed T/S merged over a selected period.

Output : plots (jpg,ps).

2.3.4 Zonal MLD (ENSEMBLES/MATLAB/ZONAL_MLD)

zonal-mean_MLDcoloc.m

zonal-median_MLDcoloc(_paper_noir-blanc).m

2.3.5 Statistics : median, percentiles (ENSEMBLES/MATLAB/MEDIAN_MLD_HCSC_TS/)

————— **Regional_distribution/** —————

distr_monthly_HCSC_MLD_TS_ENS-OPA_NNATL(_new/_paper_new/_paper_new_nb(_4reg)).m

Purpose : compute and plot the distribution (and its median and percentiles 17% and 83%) of monthly MLD,HC,SC,T,S in different regions of the North Atlantic. One plot for one month in one region.

Input : HC,SC,T,S(mld) of full model, collocated model and observations merged into monthly files over an interannual period and where NNATL has been extracted (in the ij space).

distr-bias_monthly_HCSC_MLD_TS_ENS-OPA_NNATL_new.m

distr-obs-col-bias_monthly_HC_MLD_T_ENS-OPA_NNATL_new.m

————— **Calculs/** —————

calcul_pdfmens_error_MLD-HCSC-TS_ENS-OPA_NNATL(_1zone/_1zone-from-nnatl).m

Purpose : These programs has been developed before pdfstat_MLD_HCSC_TS_ARGO_ORCA05(025).f90. They compute and plot medians and percentiles (17% and 83%) of monthtly MLD, MLT, MLS, MLHC, MLSC (biases and sampling errors).

————— Regional_cycle/ —————

cycle_monthly_HCSC_MLD_TS_ENS-OPA_NNATL.m

Purpose : compute median and percentiles 17% and 83% of the PDF of monthly MLD,HC,SC,T,S and plot them as a function of months (annual cycle) in different regions of the North Atlantic.

Input : HC,SC,T,S(mld) of full model, collocated model and observations merged into monthly files over an interannual period and where NNATL has been extracted (in the ij space).

Output : ASCII files (mat) and plots (jpg,ps).

cycle_seasonal_HCSC_MLD_TS_ENS-OPA_NNATL.m

Purpose : compute median and percentiles 17% and 83% of the PDF of seasonal MLD,HC,SC,T,S and plot them as a function of years in differents regions of the North Atlantic.

Input : HC,SC,T,S(mld) of the full model, the collocated model and the observations merged into monthly files where NNATL has been extracted (in the ij space).

Output : plots (jpg,ps).

cycle_seasonal_HCSC_MLD_TS_ENS-OPA_NNATL_pentades.m

Purpose : compute median and percentiles 17% and 83% of the PDF of sesaonal MLD,HC,SC,T,S merged into pentades and plot them as a function of pentades in differents regions of the North Atlantic.

Input : seasonal files merged into pentades of HC,SC,T,S(mld) of the full model, the collocated model and the observations and where NNATL has been extracted (in the ij space).

Output : plots (jpg,ps).

cycle_seasonal_anomalev_HCSC_MLD_TS_OPA_NNATL_pentades.m

bias-med-perc_MLD-HCSC-TS_ENS-OPA_GLOB_mens_1zone.m

Purpose : plot the median and percentiles 17% and 83% of the PDF of monthly MLD,HC,SC,T,S as a function of months, in a region (from cutting of global map) for collocated model and observations.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90.

bias-med-perc_MLD-HCSC-TS_ENS-OPA_GLOB_mens_1zone.m

Purpose : idem for MLD, MLHC and MLT.

error-med-perc_MLD-HCSC-TS_ENS-OPA_GLOB_mens_1zone(_noir-blanc).m

Purpose : plot median and percentiles 17% and 83% of the PDF of monthly MLD,HC,SC,T,S as a function of months, in a region (from cutting of global map) for full and collocated models.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90.

error-med-perc_MLD-HC-T_ENS-OPA_GLOB_mens_1zone_noir-blanc(_mask).m

Purpose : idem for MLD, MLHC and MLT.

bias-error_MLD-HCSC-TS_ENS-OPA_NNATL_mens_6zones.m

Purpose : plot for the 6 selected zones of NNATL (NordicSE, LAB, IRM, Rockall, SARG, ATLNE) and 6 monthly variables (MLD(T,S), MLHC, MLSC, MLT, MLS) : 1. sampling errors (median(collocated model) - median(full model)) using one simulation, 2. medians, percentiles 17% and 83% of the model biases (collocated model-observations) for 3 simulations.

Inputs : ASCII files (mat) created by cycle_monthly_HCSC_MLD_TS_ENS-OPA_NNATL.m

Outputs : 6 regions (= 6 subplots) on the same plot x 6 variables x 2 analyses (validation and sampling error) = 12 plots (bias/obs*NNATL.jpg).

nbT_MLD-HCSC-TS_ENS-OPA_GLOB_mens_1zone(_nb).m

Purpose : plot the number of available profiles for a selected region (from cutting of the global map) as a function of months for 2 different period.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90.

————— **Global_map/** —————

mask = where simulated ice and shallow water have been mask.

figure.txt explains how convert the global map in GIF format in order to superimpose the plots (global map and continent) produced by the following programs.

med-obs_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new_newmap2.m

Purpose : plot the maps at global scale of the medians of the observed regional monthly MLD(T,S), MLT, MLS, MLHC, MLSC.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

med-obs_MLD-HC(SC)-T(S)_ENS-OPA_GLOB_mens_new_newmap2.m

Purpose : idem for MLD, MLT(MLS), MLHC(MLSC)

med-obs-mod_MLD-HC(SC)-T(S)_ENS-OPA_GLOB_mens_new_newmap2.m

Purpose : plot the maps at global scale of the medians of the collocated observed and simulated regional monthly MLD, MLT(MLS), MLHC(MLSC).

med-comp_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new_newmap(2).m

Purpose : plot the maps at global scale of the medians of the full model regional monthly MLD(T,S), MLT, MLS, MLHC, MLSC.

med-comp-2runs_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap.m

Purpose : plot the maps at global scale of the medians of the full model regional monthly MLD, MLT, MLHC, superimpos ing results for 2 simulations.

med-comp-Xperiods_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap(_mask).m

Purpose : plot the maps at global scale of the medians of the full model regional monthly MLD, MLT, MLHC, superimpos ing results for X periods.

med-comp-crit_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap2.m

Purpose : plot the maps at global scale of the medians of the full model regional monthly MLD, MLT, MLHC, superimposing results for 2 criteria of MLD calculation.

med-col-comp_MLD-HCSC-TS_ENS-OPA_GLOB_mens(_new_newmap.m

Purpose : plot the maps at global scale of the medians of the collocated and full model regional monthly MLD(T,S), MLT, MLS, MLHC, MLSC.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

bias_MLD-HCSC-TS_ENS-OPA_GLOB_mens_2runs_new_newmap.m

Purpose : plot the maps at global scale of the regional monthly model biases (medians of bias of monthly MLD(T,S),MLT,MLS,and nbT,nbS) for 2 simulations.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

Outputs : 1 figure = 1 variable x 70 zones x 12 months (bias*.jpg + nb*.jpg +continents.jpg).

bias_MLD-HC-T_ENS-OPA_GLOB_mens_Xruns*_new_newmap.m

Purpose : idem for MLD, MLHC, MLT only.

bias_MLD-SC-S_ENS-OPA_GLOB_mens_Xruns*_new_newmap.m

Purpose : idem for MLD, MLSC, MLS only.

error_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new_newmap(_seuil/_seuil2).m

Purpose : plot the maps at global scale of the sampling errors on the regional monthly MLD(T,S), MLT, MLS, MLHC, MLSC, MLEHC (relative error).

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

Outputs : 1 figure = 1 variable x 70 zones x 12 months (obs*.jpg + continents.jpg).

error_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap_seuil2(_mask/_3period).m

Purpose : idem for MLD, MLHC, MLT only. 3period=superimposition of results for 3 periods.

error-2runs_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap.m

Purpose : idem for 2 runs.

error-mask-nomask_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap.m

Purpose : idem for 2 runs, where simulated ice and shallow water have been masked or not.

errordivstd_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new_newmap_seuils_2.m

Purpose : idem for error divided by standard deviation.

errordivwidth_MLD-HC(SC)-T(S)_ENS-OPA_GLOB_mens_new_newmap_seuils_2(_mask).m

Purpose : idem for error divided by width (p83-p17).

nb_MLD-HCSC-TS_ENS-OPA_GLOB_mens_newmap.m

Purpose : plot the maps at global scale of the number of available profiles in regional monthly bin.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

rms-error_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

Purpose : plot the the maps at global scale of the rms of the monthly regional sampling errors (collocated model-full model) of MLD(T,S), MLT, MLS, MLHC, MLSC.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

width_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

Purpose : plot the maps at global scale of the width (p83-p17) of the regional monthly MLD(T,S), MLT, MLS, MLHC, MLSC of the full model.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

std_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

Purpose : plot the maps at global scale of the standard deviation of the regional monthly MLD(T,S), MLT, MLS, MLHC, MLSC of the full model.

Inputs : ASCII files (txt) created by pdfstat_MLD_HCSC_TS_ORCA.f90

season-med_error_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap_seuils_mask_3period.m

season-med_errordivwidth_MLD-HC-T_ENS-OPA_GLOB_mens_new_newmap_seuils_mask_3period.m

————— Scatter_plot/ —————

scatter-med-merc_error_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

scatter-med-merc_error-nb_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new(_noir-blanc.m)

scatter-med-merc_error-nb_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new_noir-blanc_mask(/_bis/)

scatter-med-merc_errordivstd_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

scatter-med-merc_error-width_MLD-HCSC-TS_ENS-OPA_GLOB_mens_new_noir-blanc_mask_3p

scatter_contribution-MLD-MLT-MLHC_ENS-OPA_GLOB_mens(/_mask/_mask_flag).m

scatter_contribution_bias-MLHC-MLSC_ENS-OPA_GLOB_mens.m

scatter_error-bias_MLD-HCSC-TS_ENS-OPA_GLOB_mens_noir-blanc.m

scatter_error-bias-nb-std_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

scatter_error-nb_MLD-HCSC-TS_ENS-OPA_GLOB_mens_reg-std.m

scatter_error-std_MLD-HCSC-TS_ENS-OPA_GLOB_mens_reg-nb.m

scatter_error-width_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

scatter_med-error-width_MLD-HCSC-TS_ENS-OPA_GLOB_mens.m

————— Global_characteristic —————

find_regions_large-error.m

Purpose : find extrema

typical-errors.m

Purpose : compute mean of sampling errors

typical-var-errors.m

Purpose : compute mean of standard deviations of sampling errors

2.3.6 Sampling (ENSEMBLES/MATLAB/SAMPLING/)

nbprof_inst.m

minmax-depth-ARGO.m

coverage_index(_new/_new_corr).m

coverage_index_seafloordepth(_corrected).m

coverage_index_ileadfra(/_bis/_bis_corrected).m

2.3.7 Global Ocean heat content (ENSEMBLES/MATLAB/MODEL_STUDY/)

stdHC_global.m

stdHC_global_2ndmethod(_correct).m

distrib_stdHC.m

Global-OHC(_new).m

Global-OHC-study-areas(_new).m

nbdata_stdHC_mask-bathy.m

nbdata_global_mean-std(_ARGO/_ARGO_2/_ARGO_bathy_ice/_ARGO_bathy_ileadfra).m

Perc_stdHC.m

GLOB-NH-SH_OHCA_surface(volume).m

GLOB-NH-SH_OHCA_season-interan*.m

2.3.8 Positions of hydrographic profiles (ENSEMBLES/CHART/)

posARGO_MLDmod_month.csh

Purpose : plot MLD of the full model and the position of ARGO floats at global or regional scale.

Inputs : monthly MLD over a period of the full model (ORCA025-G70_HCSC_mldT02_10_month_period.nc), positions of collocated ARGO floats in the i,j model space created by posARGOonORCA.x (posARGOT(S)_mldT02_EN3_v1c_ORCA025-G70_month_period_zone.txt, trait-zone.txt (découpage grille comme cartes globales de validation et d'observabilité).

Outputs : *.gif for each month and animation.gif.

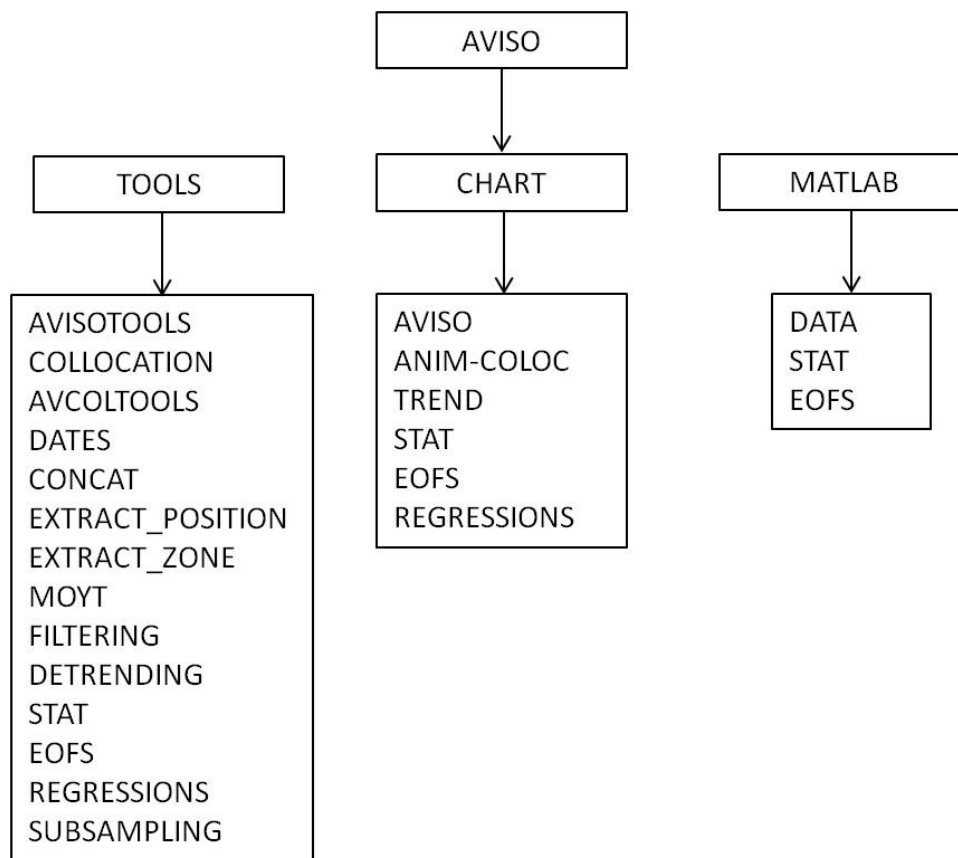
posEN3_BABY15.csh

Purpose : plot MLD of the full model and the position of collocated ENSEMBLES/model profiles onto the BABY15 grid.

3 AVISO

The AVISO altimetric database provides weekly and gridded (Mercator $1/3^\circ \times 1/3^\circ$ grid) sea level anomalies ($SLA(x, y, t)$) at quasi-global scale (merged SLA from Topex/Poseidon or Jason-1+ERS-1/2 or ENVISAT). The SLA are calculated with the reference period 1993-1999. The NetCDF files are available from 1993 to present.

For details http://www.jason.oceanobs.com/html/donnees/produits/hauteurs/global/msla_fr.html.



3.1 Overview of AVISO data (AVISO/TOOLS/AVISOTOOLS/)

The following programs are available in AVTOOLS.tar.

3.1.1 Temporal mean

temporal_moy_avisobrute.f90

Purpose : compute the temporal mean of AVISO SLA.

Inputs : AVISO files.

Output : temporal mean SLA.

Usage : temporal_moy_avisobrute.x ncfiles.

Associated routine : mod_avisobrute.f90

3.1.2 Spatial mean

metric_avisobrute.f90

Purpose : compute metrics of AVISO file.

Inputs : AVISO file.

Output : metric file.

Usage : metric_avisobrute.x ncfile

Associated routine : mod_avisof90

Associated script : 1st operation of script_meanxy_avisobrute.ll

spatial_mean_avisobrute.f90

Purpose : compute the global spatial mean of AVISO SLA.

Inputs : AVISO file.

Output : spatial mean value.

Usage : spatial_mean_avisobrute.x ncfile ncmetric

Associated routine : mod_avisof90

Associated script : 2nd operation of script_meanxy_avisobrute.ll

3.1.3 Format

convert_format_avisocdf.f90

Purpose : convert AVISO files into the SESAM NetCDF format.

Inputs : AVISO file.

Usage : convert_format_avisocdf.x ncfile

Associated routine : mod_avisof90

3.2 Collocation MODEL-AVISO (AVISO/TOOLS/COLLOCATION/)

3.2.1 Calculation of collocated simulated and observed SLA

grid_orca2merc(_ORCA1/_ORCA2).f90

Purpose : collocation of ORCA grid on Mercator grid : compute the weights w_1, w_2, w_3, w_4 necessary to compute the equivalent model at the observation point.

Input : AVISO file and OPA file.

Output : collocated grids file.

Usage : grid_orca2merc.x < list.txt (config of input files (OPA and AVISO) output file (collocated grid), periodicity of ORCA grid).

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_math.f90, mod_avisof90, mod_loc(_ORCA1).f90.

Associated script : script_gridopa2avisoll, script_gridopa2avisofilt.psb

opa2avisof90

Purpose : spatial and temporal collocation and interpolation of DRAKKAR SSH on AVISO SLA (Mercator grid).

Input : collocated grids file (created by grid_orca2merc(_ORCA1/_ORCA2).f90), AVISO weekly files (SLA) and OPA files (each 5 days, original or "without" ice).

Output : weekly collocated simulated SSH and observed SLA (with a common ice mask) files.
Note : these files have to be corrected (script_correction.ll), see after...

Usage : opa2avisox < list.txt (nomenclatures of OPA and AVISO input files and of the output file, type of OPA variables, dates of OPA and AVISO files, name of the collocated grid file, reajustement)

Associated routines : cdfio.f90 (CDFTOOLS), mod_lin.f90, mod_opa.f90, mod_avisof90

Associated script : script_opa2avisoll, script_opa2avisolastyear.11, script_opa2avisofilt.psb

temporal_moy_aviso.f90,sla_minus_moyt.f90

Purpose : compute the temporal mean over 1993-1999 at each point (x,y) then remove the temporal mean : $SLA(obs)=SLA(obs)-SLA_{moy}(obs)$ and $SLA(mod)=SSH(mod)-SSM_{moy}(mod)$.

Input : output files created by opa2aviso.f90.

Output : collocated simulated and observed SLA files.

Associated routine : mod_output_nocorrected.f90

Associated script : 1st operation of script_correction.ll, script_correction_filt.psb

convert_formatcdf.f90

Purpose : conversion into SESAM NetCDF format.

Input : collocated simulated and observed SLA files.

Output : collocated simulated and observed SLA files at SESAM format.

Associated routine : mod_aviso_interp.f90

Associated script : 2nd operation of script_correction.ll, script_correction_filt.psb

metric_aviso.f90, spatial_mean_aviso.f90, sla_minus_meanxy.f90

Purpose : compute the global spatial mean at each snapshot then remove the spatial mean : $SLA = SLA - SLA_{meanxy}$.

Input : previous files

Output : corrected files (no trend XY).

Associated routine : mod_aviso_interp_cdf.f90 (*=mod_coloc ?*)

Associated scripts : 3rd operation of script_correction.ll, script_correction_filt.psb, and script_meanxy.ll

opa2aviso_climato.f90

The same as opa2aviso.f90, but adapted to monthly averaged data files.

3.2.2 Calculation of collocated simulated variables

opa2aviso_SSHmod2gridobs.f90

Purpose : spatial collocation and interpolation of DRAKKAR SSH at the observations point (Mercator grid).

Input : collocated grids file (created by grid_orca2merc(_ORCA1/_ORCA2).f90) and OPA files.

Output : collocated simulated SSH at the observation point. Note : these files have to be corrected , see after...

Usage : opa2aviso_SSHmod2gridobs.x < list.txt

Associated routines : cdfio.f90 (CDFTOOLS), mod_lin.f90, mod_opa.f90

Associated script : first step of script_opa2aviso_SSHmod2gridobs.cshlocal or multistep_opa2aviso_SSHnoicemod2gridobs.ll

metric_SSHmodcoloc.f90, spatial_mean_SSHmodcoloc.f90, ssh_minus_meanxy_SSHmodcoloc.f90

Purpose : compute the global spatial mean at each snapshot then remove the spatial mean : $SSH = SSH - SSH_{meanxy}$.

Input : collocated simulated SSH

Output : corrected files (no trend XY).

Associated routine : mod_SSHmodcoloc.f90

Associated scripts : 2nd step of script_opa2aviso_SSHmod2gridobs.cshlocal or multistep_opa2aviso_SSHnoicemod2gridobs.ll

opa2aviso_SSTmod2gridobs.f90

Purpose : spatial collocation and interpolation of DRAKKAR SST at the observations point (Mercator grid).

Input : collocated grids file (created by grid_orca2merc(_ORCA1/_ORCA2).f90) and OPA files.

Output : collocated simulated SST at the observation point.

Usage : opa2aviso_SSTmod2gridobs.x < list.txt

Associated routines : cdfio.f90 (CDFTOOLS), mod_lin.f90, mod_opa.f90

Associated script : multistep_opa2aviso_SSTmod2gridobs.ll

opa2aviso_ileadframod2gridobs.f90

Purpose : spatial collocation and interpolation of DRAKKAR ice concentration at the observations point (Mercator grid).

Input : collocated grids file (created by grid_orca2merc(_ORCA1/_ORCA2).f90) and OPA files.

Output : collocated simulated ice concentration at the observation point.

Usage : opa2aviso_ileadframod2gridobs.x < list.txt

Associated routines : cdfio.f90 (CDFTOOLS), mod_lin.f90, mod_opa.f90

Associated script : script_opa2aviso_ileadframod2gridobs.cshlocal

opa2aviso_bathy.f90

Purpose : collocation and interpolation of DRAKKAR bathymetry on AVISO bathymetry (Mercator grid)

Input : the file of collocation of ORCA grid on Mercator grid (created by grid_orca2merc(_ORCA1/_ORCA2).f90) and model bathymetry file.

Output : collocated bathymetry file.

Usage : opa2aviso_bathy.x < list_opa2aviso_bathy.txt (nomenclature of OPA file and name of the collocated grid file)

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90

Associated script : script_opa2aviso_bathy.ll

3.3 Post-processing of collocated data

The post-processing uses programs written in Fortran 90 stored in AVISO/TOOLS/AVCOLTOOLS/ or included in cdfop.x or in the SESAM tool. Most of scripts require NCO.

The following programs are available in AVTOOLS.tar.

3.3.1 Dates (AVISO/TOOLS/DATES)

Purpose : extract dates and save them in ASCII file.

Associated script : script_dates.ll

3.3.2 Concatenation (AVISO/TOOLS/CONCAT/)

Purpose : concatenation of files of collocated SLA.

Associated scripts : concat_period(_deseason/_detrend/_BFdetrend).ll,
script_concat_ileadframod2gridobs.cshlocal

3.3.3 Extraction of position (AVISO/TOOLS/EXTRACTION_POSITION/)

nearest_point.f90

Purpose : determination of the closest i,j index (grid points) for a longitude and a latitude given in argument (in degree). The associated scripts extract time series of collocated SLA at a selected geographic point or a selected latitude.

Associated routine : mod_coloc.f90

Associated scripts : data_pointfixe(-ij)_trend-detrend.ll (detrended and not detrend signals), data_pointfixe_brut-deseason.ll (original and deseasonal signals), data_pointfixe_brut-filt.ll (filtered and not filtered signals), data_pointsfixes(_detrend).ll (several geographic points selected in a ASCII file), extract_latfixe.ll.

3.3.4 Extraction of region (AVISO/TOOLS/EXTRACTION_ZONE/)

extract_NATL.f90

Purpose : extract the North Atlantic region of global collocated AVISO/model files.

Associated routine : mod_coloc.f90

Associated script : extract_NATL-MED.ll, concat_NATL-MED.ll

extract_MED.f90

Purpose : extract the Mediterranean Sea of global collocated AVISO/model files.

Associated routine : mod_coloc.f90

Associated script : extract_NATL-MED.ll, concat_NATL-MED.ll

nco

Purpose : extraction of a region.

Associated scripts : extract_bde-par.ll, extract_zone.ll

3.3.5 Temporal mean (AVISO/TOOLS/MOYTT/)

temporal_moy_avisof90

Purpose : calculation of temporal mean

Associated scripts : script_moytSSH.ll

tmean (cdfop)

Purpose : calculation of temporal mean

Associated scripts : script_moy-month_SSHnoice.ll

tmean (cdfop)

Purpose : calculation and soustraction of the monthly mean over a period

Associated scripts : soustract_moy_monthly(_filt).ll

3.3.6 Filtering (AVISO/TOOLS/FILTERING/)

The Lanczos filter is a low-pass filter. Ncoup=cutoff wavelenght in number of grid points.

BF=low-frequency, MF=mid-frequency, HF=high frequency, GE=large-scale, PE=small-scale.

filtwinlanc (cdfop)

Purpose : spatial 2D Lanczos 2D filtering of the N variables. Ncoupi are the cutting length scales for each variable.

Usage : cdfop.x filtwinlanc N filein.cdf fileout.cdf var1 ... varN Ncoup1 ... NcoupN

Associated routines : initlanc2d.f, ufiltilanc.f

Associated script : spatial_filtering(-detrend/-detrend_GE-PE).ll, multistep_spatial_filtering(-detrend).ll

filttwinlanc (cdfop)

Purpose : temporal 1D Lanczos filtering of the N variables. Ncoupi are the cutting length scales for each variables.

Usage : cdfop.x filttwinlanc N filein.cdf fileout.cdf var1 ... varN Ncoup1 ... NcoupN

Associated routine : initlanc.f

Associated script : temporal_filtering(/-deseason/-detrend).ll (not filtered → BF, spatially filtered GE → GEBF), temporal_filteringBFMFHF.ll (not filtered → BF,MF,HF), temporal_filteringMFHF.ll (MF,HF from BF), temporal_filtering_monthlySSH.cshlocal (2 heures pour 12moisx314ans pas de temps), multistep_temporal_filteringBFMFHF.ll, multistep_temporal_filtering_monthlySST.ll

Others filters (cdfop)

filttwin : cdfop.x filttwin N filein.cdf fileout.cdf var1 ... varN N1 ... NN (temporal filtering by window mean method)

filtlanczos : cdfop.x filtlanczos N fileout.cdf var1 ... varN Ncoup1...NcoupN (spatial filtering with Lanczos 1D, applied to X axis then to Y axis)

3.3.7 Detrending (AVISO/TOOLS/DETRENDING/)

tlinreg (cdfop)

Purpose : compute time linear regression of variable v($v=at+b$) and the Pearson coefficient r

Usage : cdfop.x tlinreg in.cdf out.cdf varin a b r

Associated script :

- lin_reg.ll : compute the linear regression
- detrend.ll : detrend the signal (soustraction the linear trend)

3.3.8 Statitics (AVISO/TOOLS/STAT/)

tcor, tvar, trms2, tmean (cdfop)

Purpose : compute statistics of the filtered (BF,MF,HF) or not signal : temporal correlation, temporal variance, temporal variance (model) / temporal variance (AVISO), $\log_{10}[\text{temporal variance (model) / temporal variance (AVISO)}]$, temporal variance (filtered signal) / temporal variance (not filtered signal), temporal standard deviation, temporal standard deviation (filtered signal) / temporal standard deviation (not filtered signal), temporal root mean square difference, mean difference, Bcond, Buncond, skill score

Input : file merged over all the period (created during the filtering)

Usage :

- cdfop.x tcor 2 filein.cdf fileout.cdf var1 var2
- cdfop.x tvar N filein.cdf fileout.cdf var1 varN

- cdfop.x trms2 2 filein.cdf fileout.cdf var1 var2
- cdfop.x tmean N filein.cdf fileout.cdf var1 varN
- and mathematical operators of cdfop

Associated script :

- computing statistics : stat.ll, stat_icemasktot.ll, stat2(_detrend).ll,stat3.ll
- computing difference of statistical quantites :
 - comp_cor-sign.ll : difference of the correlations of the 2 runs, only if at least one value of the 2 runs is significant. input = file of correlation created by stat.ll and stat_icemask.ll
 - comp_cor-sign2.ll : idem but input = file of statistics created by stat2.ll
 - comp_cor.ll : difference of the (all) correlations of the 2 runs
 - comp_std_BF-GEBF.ll : difference standard deviation between BF and GEBF signals
 - comp_SS-Bcond-Buncond.ll : difference of Bcond, Buncond and skill score of the 2 runs

mask

Purpose : mask the statistic files with the global mask (ie over all the period), which is created by mask_global.ll (necessary for the compute of EOFs)

Associated script : stat_icemasktot.ll, and used in stat2(_detrend).ll,stat3.ll

cdfVonStorchCorr(_intermod).f90

Purpose : compute correlation and threshold of significativity from Von Storch and Zwiers

Associated script : first step of cor_vonstorch(_detrend/_intermod_detrend).ll

VonStorchCorr.f90

Purpose : mask non significant correlation from Von Storch and Zwiers

Associated script : second step of cor_vonstorch(_detrend/_intermod_detrend).ll

stat_forced_forced signal.f90

Purpose : compute standard deviation and correlation of the forced signal from the interannual and climatological signals.

Associated script : stat_forced_detrend.ll

3.3.9 EOFs (AVISO/TOOLS/EOFS/)

sesam_SLAaviso, sesam_SLAmodinterp (SESAM)

Purpose : compute of EOFs at global or regional scale.

Input : corrected collocated simulated and observed SLA files.

Output : spatial modes (Netcdf files) and temporal amplitudes (ASCII files).

Associated script : mask_global(_subsmplx/_detrend).ll (mask at global scale.!! mask(not filtered) different from mask (filtered in space)!!) then eof(/_detrend/_deseason/_detrend_subsmplx).ll (global or regional EOFs)

calcnorm (cdfop)

Purpose : compute the norme of simulated and observed modes and projection of model states on the observed modes (global or regional)

Usage : cdfop.x calcnorm N filein.cdf var1 ... varN (compute the norm and print time and norm on the screen)

Associated script : normode_projeof(/_detrend/_deseason).ll (normes_modes.ll)

projeof (cdfop)

Purpose : projection of model states on observed modes (vctXXX.cdf)

Usage : cdfop.x projeof 2 vctXXX.cdf state.cdf SLAaviso SLAmodel (print : time projCl(k)
lambda(k))

Associated script : normode_projeof(/_detrend,/_detrend_subsmplxtyt).ll

sigprojeof (cdfop)

Purpose : recomposition of the simulated signal which has been projected on the observed modes (with observed spatial modes and model projections on these modes)

Usage : cdfop.x sigprojeof 2 vctconcat.cdf mod_statprojs.txt out.cdf VAR1 VAR2, with vctconcat.cdf is the concatenation of all observed modes, mod_statprojs.txt contains all projections of the model on these modes, VAR1=observed variable, VAR2=model variable.

Associated script : sigprojeof_detrend_subsmplxtyt.ll

Cumulated inertia

Purpose : cumulated inertia, which is computed during the calculation of EOFs and stored in the file sesam.output

Associated script : cumul_inertie.ll

Eigen values

Purpose : eigen values, which is computed during the calculation of EOFs and stored in the file sesam.output

Associated script : eigen_val(_detrend).ll

3.3.10 Regression (AVISO/TOOLS/REGRESSIONS)

regression_NAO_GLOB_Y1(/Y3).f90

Purpose : compute the regression of collocated AVISO/model SLA with the NAO index.

Associated routine : mod_coloc.f90

Associated script : regressions_SLA_Y3.ll, regressions_SLA-deseason_Y3_NAO-season.ll, regressions_SLA_NAOfilt_Y1.ll

sladecomp.f90, bcproc.f90, bt2bcproc.f90, hbcprocess.f90

Purpose : working on the barotropic and baroclinic signals from the regressions of SLA and BSF.

Associated script : bcproc_regSLA-BSF.ll, bcproc_regSLA-BSF_deseason_filt.ll, hbcprocess_SLA_BSF.ll

3.3.11 Subsampling (AVISO/TOOLS/SUBSAMPLING/)

subsmpl (cdfop)

Associated script : subsample_detrend.ll

3.3.12 Others operators (cdfop)

log10

Usage : cdfop.x log10 N filein.cdf fileout.cdf var1 ... varN

interval

Usage : cdfop.x interval 1 filein.cdf fileout.cdf var1 ... varN valmin valmax (valmin<values<valmax=values if not spval)

extimidx

Usage : cdfop.x extimidx N filein.cdf fileout.cdf var1 ... varN indextime (N=number of variables without lon, lat, depth, time)

tmerge, tmean

Usage tmerge : cdfop.x tmerge N inout.cdf in2.cdf var1 ... varN

Usage tmean : cdfop.x tmean 2 filein.cdf fileout.cdf var1 ... varN

Associated script : soustract_moy-month.ll : compute deseasonal SLA.

3.4 Visualisation

Chart, Matlab.

3.4.1 Overview of AVISO files (AVISO/CHART/AVISO/)

verif_AVISO.csh (chart)

Purpose : check that the temporal mean of AVISO SLA over 1993-1999 (period of reference) is equal to zero.

Inputs : AVISO files.

time_series_av_brutes.csh (chart)

Purpose : extraction of time serie of AVISO SLA at a selected geographic point.

Inputs : AVISO files.

Output : ASCII files.

3.4.2 Animations of collocated SLA (AVISO/CHART/ANIM-COLOC)

anim_coloc_1var.csh (chart)

Purpose : animation of one collocated variable (AVISO or model SLA) over all the period.

Inputs : collocated files of SLA (filtered or not).

Output : annual.gif and animation.gif aver all the period.

anim_coloc_2var.csh (chart)

Purpose : animation of the collocated AVISO and model SLA over all the period.

Inputs : collocated files of SLA (filtered or not).

Output : annual.gif and animation.gif aver all the period.

anim_coloc_3var.csh (chart)

Purpose : animation of the collocated AVISO and 2 model SLA over all the period.

Inputs : collocated files of SLA (filtered or not).

Output : annual.gif and animation.gif aver all the period.

anim_monthly-mean.csh (chart)

Purpose : animation of the monthly collocated AVISO and model SLA over all the period.

Inputs : files of monthly means SLA (filtered or not) over all the period.

Output : animation.gif over all the period.

3.4.3 Mean collocated data (AVISO/MATLAB/DATA)

meanxy.m : plot global spatial mean over a period of collocated AVISO/model SLA before removal of spatial mean (trendXY).

MSSH_globalmap_flat.m

time_averaged_SSH_TP.m

3.4.4 Linear regression (AVISO/CHART/TREND)

fig_tlinreg_coloc.csh (chart)

Purpose : plot areg and breg (from the linear regression $SLA(x,y,t) = areg(x,y)*t + breg(x,y)$) of the collocated AVISO and MODEL SLA.

Input : file of linear regression of the filtered or not collocated AVISO/model SLA.

fig_diff_areg.csh (chart)

Purpose : plot the difference areg of AVISO and model SLA.

Input : file of the difference of linear regression between AVISO and model SLA.

3.4.5 Statistics

In AVISO/CHART/STAT/

fig_stat_temp_brute.csh, fig_stat_temp_brute_mask(2).csh (chart)

Purpose : plot the statistics of the not filtered collocated observed and simulated SLA (mask=common mask applied, 2=significant correlation instead of correlation).

Inputs : files created by stat.ll and stat.icemasktot.ll.

fig_stat_temp_filt.csh, fig_stat_temp_brute_filt(2).csh (chart)

Purpose : idem for the filtered signals.

fig_stat2_mask.csh (chart)

Purpose : plot the statistics of the filtered or not collocated SLA (significant correlation, $\log_{10}[\text{variance}(\text{model})/\text{variance}(\text{obs})]$, standard deviation of obs and model, variance(filtered signal) / variance(total signal) for obs and mod).

Input : file created by stat2.ll (stat*_mask.cdf).

fig_stat3_mask.csh (chart)

Purpose : plot the statistics of the filtered or not collocated SLA (standard deviations of collocated AVISO and model SLA, significant temporal correlation, mean error, RMS difference, skill score, temporal correlation, Bcond, Buncond).

Input : file created by stat3.ll (stat2*_mask.cdf).

fig_comp_cor-sign_filt_mask2.csh (chart)

Purpose : plot the difference between the significant correlations of collocated SLA from different runs (filtered signal only).

Input : file created by comp_cor-sign(2).ll.

fig_comp_std_BF-GEBF_mask.csh (chart)

Purpose : plot the difference of standard deviation between collocated simulated SLA from BF (low frequency) and GEBF (low frequency+large scale) signals.

Input : file created by comp_std_BF-GEBF.ll.

fig_comp_ss-Bcond-Buncond_mask.csh (chart)

Purpose : plot the difference between the Skill Score, Bcond, Buncond of collocated SLA from different runs (filtered signal only).

Input : file created by comp_SS-Bcond-Buncond.ll.

fig_cor_vonstorch.csh, fig_corsig_vonstorch.csh, fig_corsig_vonstorch_BF_detrend.csh

Purpose : plot significant correlations (from Von Storch)

fig_diff_cor_vonstorch.csh, fig_diff_cor_vonstorch_BF_detrend.csh

Purpose : plot the difference between significant correlations (from Von Storch) from different runs

In AVISO/MATLAB/STAT/

cor_lat*.m : plot the correlation as a function of the latitude.

diff_cor_lat.m : plot the difference of correlation as a function of the latitude.

cor_dist_coast*.m : plot the correlation as a function of the distance from the coast.

corsig_dist_coast*.m : plot the significant correlation as a function of the distance from the coast.

cor_topo.m : plot the correlation as a function of the topography.

std_lat*.m : plot the std as a function of the latitude.

ratio_std_lat.m : plot the $\log(\text{std}(\text{mod})/\text{std}(\text{obs}))$ as a function of the latitude.

std_scatter*.m

std_lat_2runs-T-I_BFdet.m, std-cor_lat_2runs-T-Idet_liss.m : for the interannual and climatological signals.

3.4.6 EOFs

In AVISO/CHART/EOFS/

fig_av_mod_EOFS(_3).csh, fig_av_mod_EOFS_2(_deseaon/_detrend(_subsmplxty)).csh (chart)

Purpose : plot global or regional EOFs (4 principal spatial modes) of filtered or not filtered collocated AVISO/model SLA.

fig_sigprojeof_detrend_subsmplxty.ll, anim_sigprojeof_2runs_detrend_subsmplxty.ll (chart)

Purpose : plot the simulated signal, the recomposed simulated signal which has been projected on the observed modes, and the difference.

In AVISO/MATLAB/EOFS/

apl_eof.m : AVISO temporal amplitude superposed to model temporal amplitude for the 4 first modes

proj_eof_1run.m, proj_eof_2(/3/4)runs.m, proj_eof_4runs_detrend.m : plot the model projections and the AVISO amplitudes on the same illustration, for the 4 first modes.

DrawTaylor.m (MyTaylor(2).m,polar1.m) : diagrams of Taylor of statistics of spatial modes, amplitudes, projections ...

proj_eof_NAO_1run.m, proj_eof_NAO_2runs.m, proj_eof_NAO_3(/4)runs(_brut).m : plot the superposition of the NAO index + amplitude of the mode 1 of AVISO in NATL + the projections of the runs on the observed model in NATL, and compute and plot the lagged correlation(NAO index,PC1).

proj_eof_NAO_4runs_detrend.m idem with detrended signals.

proj_eof_NAOweek_4runs(_brut/_detrend).m idem with weekly NAO.

proj_eof_ENSO_2runs.m

proj_eof_SAM_2runs.m

stat_proj_eof_4(5)regions(_detrend).m : plot diagrams with correlations and % variances of amplitudes (AVISO) vs projections (model) of the 4 first modes in 4 regions (NATL,GS,pac-eq,indien,austral) for the LF signal of the runs ORCA025-G70, ORCA05-G70 and ORCA2-G70.

stat_proj_eof_lagNAO.m : plot the diagram of lagged correlations between NAO and data(AVISO, ORCA025-G70, ORCA05-G70 et ORCA2-G70) for the LF signal in NATL and Gulf Stream, and for the LS-LF signal in NATL.

stat_prof_eof_lagNAOweek_detrend.m idem with weekly NAO and detrended signal.

stat_prof_eof_lagNAOweek_NATL-GS-BF-GEBF.m : idem with weekly NAO in NATL and GulfStream regions for LF and LS-LF signals

cumulinert.m : plot the superposition of the cumulated inertia : model // AVISO ; no filtered // BF ; modes ; regions

cumul_eof.m

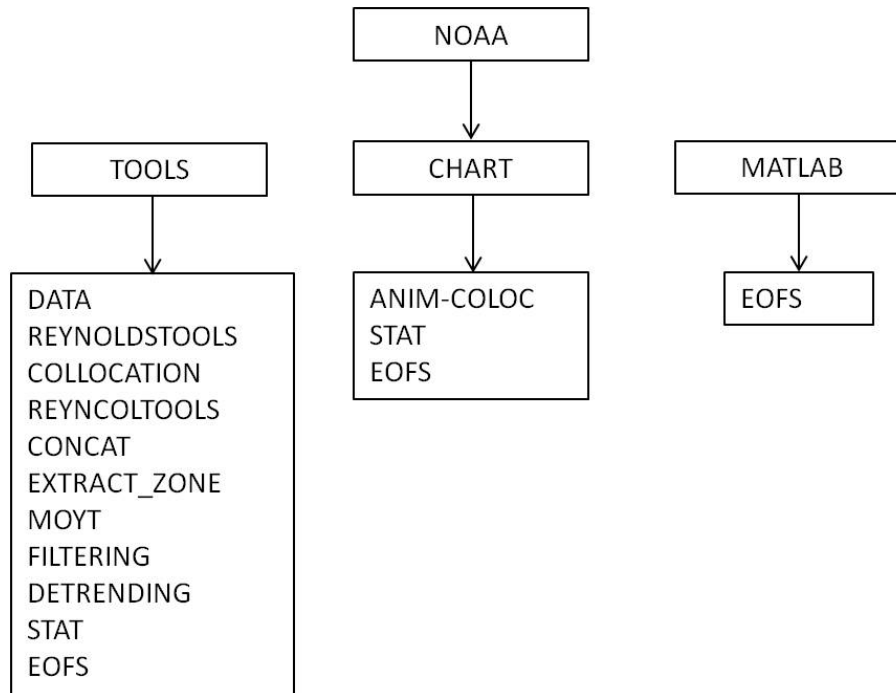
cumul_projeof.m

3.4.7 Regressions with NAO (AVISO/CHART/REGRESSIONS/)

fig_SLA_reg_NAO_mask(_deseason/_deseason2).csh (chart)

Purpose : plot the regression of filtered or not SLA (SLAaviso,SLAmodinterp) with NAO at global or regional scale (deseason=applied to deseasonal signal).

4 NOAA



4.1 Pre-processing of Reynolds SST

4.1.1 Conversion into Netcdf format (NOAA/TOOLS/DATA)

readsstweek.f90

Purpose : convert into Netcdf format

Associated script : script_convert2cdf.csh

4.1.2 Ice mask (NOAA/TOOLS/REYNOLDSTOOLS/)

mask_reyn.f90

Purpose : ice mask from SST reynolds over a selected period.

Input : Reynolds SST files merged into one file (ncfile).

Output : ice mask.

Usage : mask_reyn.x ncfile

Associated routine : mod_reyn.f90

Associated script : multistep_icemask_reynolds.csh

4.2 Collocation Model-Reynolds (NOAA/TOOLS/COLLOCATION/)

4.2.1 Calculation of collocated simulated and observed SLA

grid_orca2reyn(_ORCA1/_ORCA2).f90

Purpose : collocation of ORCA grid on the Reynolds grid : compute the weights w_1, w_2, w_3, w_4 necessary to compute the equivalent model at the observation point.

Input : Reynolds file and OPA file.

Output : collocated grids file.

Usage : grid_orca2reyn.x < list.txt (config of input files (OPA and Reynolds) output file (collocated grid), periodicity of ORCA grid).

Associated routines : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_math.f90, mod_reyn.f90, mod_loc(_ORCA1).f90.

Associated script : script_grid_opa2reynolds.csh

Other script : script_grid_avis02reynolds.csh (for the collocation of the AVISO grid (SLA) onto the Reynolds grid (SST))

opa2reyn.f90

Purpose : spatial and temporal collocation and interpolation of DRAKKAR SST on Reynolds SST.

Input : collocated grids file (created by grid_orca2reyn(_ORCA1/_ORCA2).f90), Reynolds weekly files (SST) and OPA files (each 5 days, original or "without" ice).

Output : weekly collocated simulated and observed SST (with a common ice mask) files.

Usage : opa2reyn.x < list.txt (nomenclatures of OPA and Reynolds input files and of the output file, type of OPA variables, dates of OPA and Reynolds files, name of the collocated grid file, reajustement)

Associated routines : cdfio.f90 (CDFTOOLS), mod_lin.f90, mod_opa.f90, mod_reyn.f90

Associated script : multistep_opa2reynolds.csh, script_opa2reynolds.ll, script_opa2reynolds_lastyear.ll
(Rq : on prend les deux 1ers fichiers ORCA de l'année suivante car décalage de -2.5 jours dans le code, c est nécessaire pour ORCA1 (SST) qui a des dates différentes de ORCA1(SSH) et des autres runs).

Other script : script_avis02reynolds.csh (for the interpolation of AVISO SLA onto the Reynolds grid)

4.3 Post-processing of collocated data

The post-processing uses programs written in Fortran 90 stored in NOAA/TOOLS/REYNCOLTOOLS/ or included in cdfop.x or in the SESAM tool. Most of scripts require NCO.

4.3.1 Concatenation (AVISO/TOOLS/CONCAT/)

Purpose : concatenation of files of collocated SST.

Associated scripts : multistep_concat_period.ll

4.3.2 Extraction of region (NOAA/TOOLS/EXTRACTION_ZONE/)

extract_SST_MED.f90

Purpose : extract the Mediterranean Sea of global collocated Reynolds/model files.

Associated routine : mod_SST_coloc.f90

Associated script : extract_NATL-MED.ll, concat_NATL-MED.ll

4.3.3 Temporal mean (NOAA/TOOLS/MOYT/)

tmean (cdfop)

Purpose : calculation and soustraction of the monthly mean over a period

Associated scripts : soustract_moy_monthly.ll

4.3.4 Filtering (NOAA/TOOLS/FILTERING/)

The Lanczos filter is a low-pass filter. Ncoup=cutoff wavelenght in number of grid points.

BF=low-frequency, MF=mid-frequency, HF=high frequency, GE=large-scale, PE=small-scale.

flttwinlanc (cdfop)

Purpose : temporal 1D Lanczos filtering of the N variables. Ncoupi are the cutting length scales for each variables.

Usage : cdfop.x flttwinlanc N filein.cdf fileout.cdf var1 ... varN Ncoup1 ... NcoupN

Associated routine : initlanc.f

Associated script : temporal_filtering(_MFHF).csh, multistep_temporal_filteringBFMFHF(_detrend).csh

4.3.5 Detrending (AVISO/TOOLS/DETRENDING/)

tlinreg (cdfop)

Purpose : compute time linear regression of variable $v(v=at+b)$ and the Pearson coefficient r

Usage : cdfop.x tlinreg in.cdf out.cdf varin a b r

Associated script :

- lin_reg.ll : compute the linear regression
- detrend.ll : detrend the signal (soustraction the linear trend)

4.3.6 Statitics (AVISO/TOOLS/STAT/)

tcor, tvar, trms2, tmean (cdfop)

Purpose : compute statistics of the filtered (BF,MF,HF) or not signal : temporal correlation, temporal variance, temporal variance (model) / temporal variance (Reynolds), $\log_{10}[\text{temporal variance (model) / temporal variance (Reynolds)}]$, temporal variance (filtered signal) / temporal variance (not filtered signal), temporal standard deviation, temporal standard deviation (filtered signal) / temporal standard deviation (not filtered signal), temporal root mean square difference, mean difference, Bcond, Buncond, skill score

Input : file merged over all the period (created during the filtering)

Usage :

- cdfop.x tcor 2 filein.cdf fileout.cdf var1 var2
- cdfop.x tvar N filein.cdf fileout.cdf var1 varN
- cdfop.x trms2 2 filein.cdf fileout.cdf var1 var2
- cdfop.x tmean N filein.cdf fileout.cdf var1 varN
- and mathematical operators of cdfop

Associated script :

- computing statistics : stat3(_mask/_detrend_mask).ll
- computing difference of statistical quantites :
 - comp_cor-sign.ll : difference of the correlations of the 2 runs, only if at least one value of the 2 runs is significant. input = file of correlation created by stat3.ll
 - comp_SS-Bcond-Buncond.ll : difference of Bcond, Buncond and skill score of the 2 runs

mask

Purpose : mask the statistic files with the global mask (ie over all the period), which is created by mask_global.ll (necessary for the compute of EOFs)

Associated script : stat3(_mask/_detrend_mask).ll

cdfVonStorchCorr(_intermod).f90

Purpose : compute correlation and threshold of significativity from Von Storch and Zwiers

Associated script : first step of cor_vonstorch_detrend.ll

VonStorchCorr.f90

Purpose : mask non significant correlation from Von Storch and Zwiers

Associated script : second step of cor_vonstorch_detrend.ll

mask (cdfop)

Purpose : ice mask on the correlation files

Associated script : mask_corsig_vonstorch_detrend.ll

4.3.7 EOFs (AVISO/TOOLS/EOFS/)

sesam_SLAaviso, sesam_SLAmointerp (SESAM)

Purpose : compute of EOFs at global or regional scale.

Input : corrected collocated simulated and observed SLA files.

Output : spatial modes (Netcdf files) and temporal amplitudes (ASCII files).

Associated script : multistep_mask_global.ll (mask at global scale.!! mask(not filtered) different from mask (filtered in space)!!) then eof(/_detrend/_deseason).ll (global or regional EOFs)

calcnorm (cdfop)

Purpose : compute the norme of simulated and observed modes and projection of model states on the observed modes (global or regional)

Usage : cdfop.x calcnorm N filein.cdf var1 ... varN (compute the norm and print time and norm on the screen)

Associated script : normode_projeof(/_detrend/_deseason).ll

projeof (cdfop)

Purpose : projection of model states on observed modes (vctXXX.cdf)

Usage : cdfop.x projeof 2 vctXXX.cdf state.cdf SLAaviso SLAmodel (print : time projCl(k) lambda(k))

Associated script : normode_projeof(/_detrend/_deseason).ll

4.4 Visualisation

Chart, Matlab.

4.4.1 Animations of SST (NOAA/CHART/ANIM-COLOC)

anim_sst.csh (chart)

Purpose : animation of the Reynolds SST over all the period.

Inputs : files of observed SST

Output : animation.gif over all the period.

anim_sst_coloc.csh (chart)

Purpose : animation of the collocated Reynolds and model SST over all the period.

Inputs : collocated files of SST (filtered or not).

Output : annual.gif and animation.gif over all the period.

4.4.2 Statistics (NOAA/CHART/STAT/)

fig_stat3.csh (chart)

Purpose : plot the statistics of the filtered or not collocated SST (standard deviations of collocated Reynolds and model SST, significant temporal correlation, mean error, RMS difference, skill score, temporal correlation, Bcond, Buncond).

Input : file created by stat3.ll (stat2*_mask.cdf).

fig_comp_cor-sign_filt_mask2.csh (chart)

Purpose : plot the difference between the significant correlations of collocated SST from different runs (filtered signal only).

Input : file created by comp_cor-sign.ll.

fig_comp_ss-Bcond-Buncond_mask.csh (chart)

Purpose : plot the difference between the Skill Score, Bcond, Buncond of collocated SST from different runs (filtered signal only).

Input : file created by comp_SS-Bcond-Buncond.ll.

4.4.3 EOFs

In AVISO/CHART/EOFS/

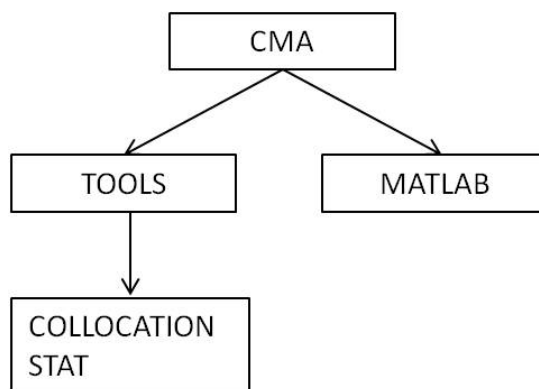
fig_EOFS(_deseason).csh (chart)

Purpose : plot global or regional EOFs (4 principal spatial modes) of filtered or not filtered collocated Reynolds/model SST.

In AVISO/MATLAB/EOFS/

proj_eof_NAOweek_5runs(_detrrend/_deseason)_corsiglag.m plot the superposition of the NAO index + amplitude of the mode 1 of Reynolds in NATL + the projections of the runs on the observed mode1 in NATL, and compute and plot the lagged correlation(NAO index,PC1).

5 CURRENT METERS



5.1 Pre-processing of observed data

The programs have been provided by Rob Scott and Greg Holloway ...

5.2 Collocation MODEL-OBS (CMA/TOOLS/COLLOCATION/)

gridopa2cm.f90

Purpose : spatial collocation of ORCA grids (gridT/U/V) on the current meter (CM) positions (x,y) : extract the model index (i,j) and compute the associated weights w1,w2,w3,w4 which will be used to compute the equivalent model at the observation point.

Inputs : model horizontal mesh file (ex : ORCA025-G70_mesh_hgr.nc), CM data file (with CM geographic positions).

Output : collocated grids file (binary format).

Usage : gridopa2cm.x < list.txt (name of model horizontal mesh file, name of CM data file, name of output file and periodicity of ORCA grid).

Associated routine : cdfio.f90 (CDFTOOLS), mod_opa.f90, mod_math.f90, mod_cm.f90, mod_loccm.f90

Associated script : (multistep_)script_gridopa2cm.ll

opa2cm.f90

Purpose : collocation and interpolation of DRAKKAR model (U,V) on CM positions (if start_time(CM) < time(model) < end_time(CM))

Inputs : collocated grids file (created by gridopa2cm.f90), the DRAKKAR model (U,V) file (5-day mean), the Current Meters data file.

Output : collocated simulated (U,V) file.

Usage : opa2cm.x < list.txt (model date (year, month, day), model vertical mesh file (ex : ORCA025-G70_mesh_zgr.nc), the 2 model (U,V) files (at the model date), the CM data file, the collocated grids file, the name of the output file.

Associated routine : mod_math.f90, cdfio.f90, mod_opa.f90, mod_cm.f90.

Associated script : multistep_script_opa2cm.ll, script_opa2cm.psb.

opa2cm_slope.f90

Purpose : collocation and interpolation of DRAKKAR model slopes (gradX,gradY) on CM positions (x,y)

Inputs : collocated grids file (created by gridopa2cm.f90), the DRAKKAR model slope (gradX,gradY) file, the Current Meters data file.

Output : collocated simulated slopes (gradX, gradY) and bottom depth file.

Usage : opa2cm_slope.x < list.txt (the model slopes file, the CM data file, the collocated grids file, the name of the output file.

Associated routine : mod_math.f90, cdfio.f90, mod_opa.f90, mod_cm.f90.

Associated script : script_opa2cm_slope.ll

5.3 Statistiques

calcul_stat.f90

Purpose : compute integrated simulated quantities over the period at the CM points.

Inputs : the merged (over a period) collocated simulated (U,V) file, the collocated simulated slopes file

Output : collocated simulated integrated variables (the same as the observed file : mean (u,v), mean(u²,v²), mean(u'v'), mean(topostrophy,atopostrophy)) file.

Usage : calcul_stat.x < list.txt (the merged collocated simulated (U,V) file, the collocated simulated slopes file, the name of the output file.

Associated routine : mod_coloc.f90.

Associated script : script(2).csh

5.4 Visualisation (CMA/MATLAB/)

5.4.1 Geographical positions

position(_newdataset).m

Purpose : geographical positions of all current meters.

5.4.2 Scatter plots

scatter.m

Purpose : geographical positions of all current meters and current meters over a selected period + distributions of the depths of all current meters and of current meters over a selected period + scatter plots between observed and simulated mean(u), mean(v), mean(u²), mean(v²), mean(u'v'), bottom, topostrophy, atopostrophy.

5.4.3 Distribution

distrib.m

Purpose : distribution of model biais (mean(u), mean(v), mean(u²), mean(v²), mean(u'v'), mean(topostrophy, mean(atopostrophy))) as a function of the depth.

distrib_lat.m

Purpose : distribution and median of observed and simulated MKE, EKE, topostrophy, atopostrophy in different latitude bands.

distrib_VAR_lat.m

with VAR = EKE (eddy kinetic energy), meanv (mean velocity), topos (topostrophy), norm-topos (normalized topostrophy)

Purpose : scatter plots, distributions and medians of observed and simulated VAR in different latitude bands of the all water column, and the [0-100m] and [1000m-bottom] layers. VAR averaged in the all water column, and the [0-100m] and [1000m-bottom] layers + baroclinicity + number of data as a function of latitudes.