Diva Lecce 2016

Diva in 4 dimensions (GODIVA)

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Acknowledgements: SeaDataNet, EMODnet Chemistry, EMODnet Biology, STARESO

Outline

Installation

See Tutorial on installation or User Guide http://modb.oce.ulg.ac.be/mediawiki/index.php/Diva_documents

Outline

Diva input info files

In `input` directory:

- Edit info files and adapt them to your case by providing in the relevant information

File name	content
`contour.depth`	list file of all depths in meters
`NCDFinfo`	metadata information for climatology NetCDF files
`general_info`	information for metadata XML files generation

Outline

Data extraction: input files preparation

In `Climatology` directory:

- `datasource` file: list of paths to ODV4 spreadsheet(s) from which data sets will be extracted.
- `varlist`, `yearlist` and `monthlist` files.
- `qflist` (quality flags) file if desired.

`varlist`	`yearlist`	`monthlist`
Temperature	19002012	0101
Salinity		0202
		0303

Data extraction: `driver` configuration & `divadoall`

In `Climatology` directory:

- Edit the `driver` file and put in a flag number for data extraction.

```
extract flag: 1 do it, 0 do nothing, -1 press coord, -10 pressure+Saunders
1
boundary lines and coastlines generation: 0 nothing, 1: contours, 2: UV, 3: 1+2
0
cleaning data on mesh: 1, 2: RL, 3: both, 4: 1 + outliers elimination, 5: =4+2
0
minimal number of data in a layer. If less, uses data from any month.
0
```

Figure 1: `driver` file configuration example.

- Run `divadoall` or `godiva` (basic error check-up included)
- Rem : do not forget to adapt the PATH (for ex. in `.bashrc`)

A subdirectory `divadata` is created in `input` directory, and contains the data sets.

Outline

Topography preparation: Diva-On-Web

http://gher-diva.phys.ulg.ac.be/web-vis/diva.html

After creating this file :

```
lonmin latmin value
lonmax latmax value
```

1. Upload the file on Diva-On-Web
2. Specify the output grid
3. Perform the analysis
4. Download the NetCDF file `diva_bath.nc`
5. Put it in `input`

```
swatelet@gher ~/DIVA/diva-4.6.11/DIVA3D/
   divastripped/input $ ../../bin/
   divabath2topogrd.a
```

Topography preparation: Diva-On-Web

=> `topo.grd` and `TopoInfo.dat` are created

If you need to erase zones, just create a mask beforehand :

- Name : masktopo.nc
- Axis : (LON and LAT) or (lon and lat)
- Variable : MASKTOPO
- Convention : 0 is erased, 1 is kept

Topography preparation, old method: `gebcomodif`

For a GEBCO topography file, use the script file `gebcomodif` to:

- Eliminate header lines
- Change depth values from negative to positive values
- Change comas to dots in decimal numbers
- Change longitude values from [0:360] to [-180:180] range
- Mask rectangle regions by giving coordinates
  in a `takeout.coord` file

Topography preparation

In `input`:

- Provide a topography file named `topogebco.asc` extracted from GEBCO Global Elevation Data.

In the `Climatology` directory:

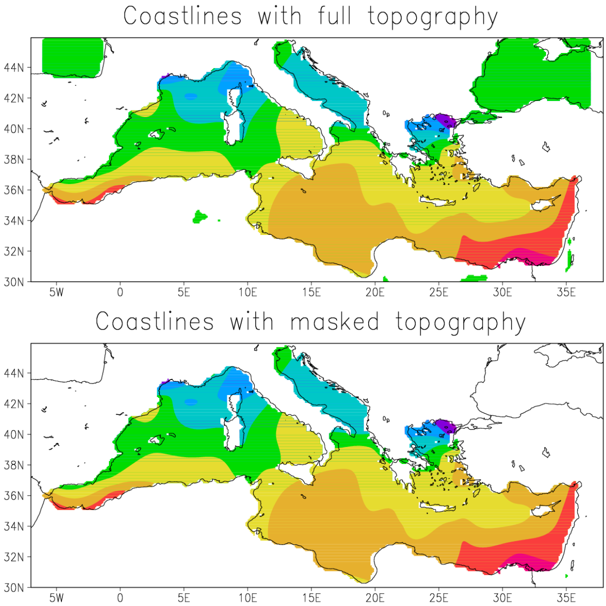
- Provide a `takeout.coord` file:

Minlon1	Maxlon1	Minlat1	Maxlat1
Minlon2	Maxlon2	Minlat2	Maxlat2
Minlon3	Maxlon3	Minlat3	Maxlat3
.	.	.	.
.	.	.	.

- Run `gebcomodif` script file.

A `topo.gebco` file is generated in `input`.

Masking regions in topography



Example of topography preparation

- In `input`, we provide `topogebco.asc` covering the Mediterranean Sea area: 30°N to 46°N and 6°W to 37°E.
- In `Climatology`, we provide a `takeout.coord` file:

```
-6. -1. 42. 46.
26.5 40. 40. 46.
5. 9. 33. 35.
20. 30. 30. 30.5
35. 37. 31. 33.
```

After running the command `gebcomodif` in `Climatology` directory, we obtain a `topo.gebco` in `input` directory.

- Or you can extract topography from diva-on-web !

Coastline files generation: input files

In `input` directory provide:

- (a) a `topo.gebco` file OR
  (b) a `topo.dat` file OR
  (c) `topo.grd` + `TopoInfo.dat` files
- the `contour.depth` file
- a `param.par` file

topo.gebco

33.966702	35.116699	12.000000
33.983299	35.116699	30.000000
34.000000	35.116699	51.000000
34.016701	35.116699	90.000000
34.033298	35.116699	179.00000
34.049999	35.116699	382.00000
34.066700	35.116699	543.00000
34.083302	35.116699	640.00000
34.099998	35.116699	691.00000

param.par

```
# Correlation Length lc in km or degree??? according to param icoordchange
1
# icoordchange (=0 if position of data in km ; =1 if position of data in degree)
1
# ispec (output files required, comments to come)
11
# ireg (mode selected for background field: 0; 1; 2)
1
# xori (origin of output regular grid, min values of X)
-9.25
# yori (origin of output regular grid, min values of Y)
30
# dx (step of output grid)
.125
# dy (step of output grid)
.125
# nx max x of output grid
367
# ny max y of output grid
129
# valex (exclusion value)
-9999.0
# snr signal to noise ratio (not yet used as such,still set as 4th value of data.dat )
0.5
# varbak variance of the background field
0.6
```

Contour.depth

```
3000
2500
2000
1750
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
250
200
150
125
100
75
50
30
20
10
0
```

Coastlines files generation: `driver` configuration

In `Climatology` directory:

- Edit the `driver` file and choose a flag number for boundary lines and coastlines generation:

Table 1: `driver` options for coastlines generation

Comment line	Flag value	Corresponding action
Boundary lines and coastlines generation:	0 :	no action is performed
	1 :	generation of contour files of boundaries and coastlines
	2 :	generation of advection UV files of velocities along coasts
	3 :	generation of contour files and advection UV files

```
Data extraction: 1 do it, 0 do nothing, -1 press coord, -10 pressure+Saunders
0
boundary lines and coastlines generation: 0 nothing, 1: contours, 2: UV, 3: 1+2
3
cleaning data on mesh: 1, 2: RL, 3: both, 4: 1 + outliers elimination, 5: =4+2
0
minimal number of data in a layer. If less, uses data from any month.
0
```

Figure 2: `driver` file configuration example.

Coastlines files generation: output

In Climatology directory

- Run divadoall

A newinput directory is created which contains:

- divaparam: a subdirectory where coastline files coast.cont.100xx are stored
- divaUVcons_all: a subdirectory where velocity field files are stored

Copy divaparam and divaUVcons_all to your input directory.

Outline

Data Cleaning: input files

In `input` directory:

- `divadata`: directory which contains data set files of the considered layers.
- `divaparam`: directory which contains coastline `coast.cont.100xx` files for all considered layers.
- the `contour.depth` file.
- a `param.par` file.

Data Cleaning: input files

In `Climatology` directory

- Provide `varlist`, `yearlist` and `monthlist` files.

- Edit the `driver` file,
- Choose a flag number for data cleaning and
- give the considered minimum layer and maximum layer numbers.

Data Cleaning: driver configuration

Table 2: `driver` *options for data cleaning*

Comment line	Flag value and corresponding action	
cleaning data on mesh	0 :	no action is performed
	1 :	cleaning data out of the mesh
	2 :	generation of relative length (RL) fields
	3 :	cleaning data out of the mesh and generations of RL fields
	4 :	cleaning data set files from outliers
	5 :	generations of RL fields and cleaning data set files from outliers

```
Data extraction: 1 do it, 0 do nothing, -1 press coord, -10 pressure+Saunders
0
boundary lines and coastlines generation: 0 nothing, 1: contours, 2: UV, 3: 1+2
0
cleaning data on mesh: 1, 2: RL, 3: both, 4: 1 + outliers elimination, 5: =4+2
5
minimal number of data in a layer. If less, uses data from any month.
0
Parameters estimation and vertical filtering:
0
Minimal L
0.5
Maximal L
3.
Minimal SN
0.1
Maximal SN
50.0
Analysis and reference field:
0
lowerlevel number
3
upperlevel number
25
```

Figure 3: `driver` *file configuration example.*

Data Cleaning: output

In `Climatology` directory:

Run `divadoall`.
A `newinput` directory is created and contains:

- `divadata` subdirectory which contains cleaned data sets
- `divadata` subdirectory which contains relative length files if generated

Copy the content of `newinput/divadata` and `newinput/divaparam` to `input/divadata` and `input/divaparam` directories.

Outline

Parameters optimisation: input

In `input` directory provide:

- `divadata` directory which contains the data set files of the considered depths.
- `divaparam` directory which contains coastline `coast.cont.100xx` files of the considered basin.
- The `contour.depth` file.
- A (template) `param.par` file.

Parameters optimisation: input files

In `Climatology` directory:

- Provide `varlist`, `yearlist` and `monthlist` files
- Edit the `driver` file and give a flag number for parameters optimisation and bounds for correlation length (L) and signal-to-noise (λ) parameters.

```
0
Parameters estimation and vertical filtering:
-30
Minimal L
0.5
Maximal L
3.
Minimal SN
0.5
Maximal SN
50.0
Analysis and reference field:
0
```

Figure 4: `driver` file configuration example.

Parameters optimisation: `driver` configuration

Table 3: `driver` options for parameters optimisation.

Comment line	Flag value	Corresponding action
Parameters optimisation and vertical filtering	0 :	no action is performed
	1 :	estimation for each level of correlation length L parameter
	2 :	estimation for each level of signal to noise ratio (λ) parameter
	-1 :	estimation and vertical filtering of L parameter
	-2 :	estimation and vertical filtering of λ parameter
	3 :	estimation for each level of L and λ parameters
	-3 :	estimation and vertical filtering of L and λ parameters
	10 :	estimation of L parameter for each level using data mean distance as a minimum
	-10 :	estimation of L parameter using data mean distance as a minimum and vertical filtering
	30 :	estimation of λ and L parameters for each level, using data mean distance as a minimum for L
	-30 :	estimation and vertical filtering of λ and L parameters, using data mean distance as a minimum for L,

Parameters optimisation: output

In `Climatology` directory:

- Run the `divadoall` script file.

A `newinput` directory is created and contains:

`divaparam` subdirectory with `param.par.100xx` files and summary files of the optimisation and filtering procedure.

Copy the content of `newinput/divaparam` to `input/divaparam` directory

Outline

Producing a Climatology: input

In `input` directory:

- `divadata` directory which contains data sets for the considered layers,
- `divaparam` directory which contains:
  - coastlines `coast.cont.100xx` files,
  - coastlines `param.par.100XX` files.
- the `contour.depth` file,
- a `param.par` file if not provided in `divaparam`

Producing a Climatology: input & and driver

In `Climatology` directory:

- Provide

  `varlist`,
  `yearlist` and
  `monthlist` files.

- Edit the `driver` file and choose a flag number for analysis.

```
Analysis and reference field:
1
lowerlevel number
5
upperlevel number
25
4D netcdf and Metadata XML metadata files genaration:
1
gnuplot plots: 0 or 1
0
Data detrending: number of groups, 0 if no detrending.
0
```

Figure 5: `driver` file configuration example.

Producing a Climatology: input & and driver

In `Climatology` directory:

Table 4: `driver` options analyses & climatologies production.

Comment line	Flag value and corresponding action	
Analysis and reference fields	0 :	no action is performed
	1 :	Perform analyses defined by a set of input files: varlist, yearlist, `monthlist`, `constandrefe` and the files in `input/` directory
	2 :	generation of reference field
	3 :	perform analyses as in 1 based on vertically filtered background
	11 :	perform analyses using a $\log$(data)-$\exp$(analysis) transformations
	13 :	perform analyses using the anamorphosis transformation
	14 :	perform analyses using a user defined transformation
	21 :	perform reference fields using a $\log$(data)-$\exp$(analysis) transformations
	23 :	perform reference fields using the anamorphosis transformation
	24 :	perform reference fields using user defined transformation
	Adding 100 to flag values 1, 11, 13 and 14 allows to perform the same action using a reference field for each layer generated on the basis of all data from the two neighbouring layers in addition to the layer data set.	
	Adding 100 to flag values 2, 21, 23 and 24 allows to perform reference fields with the same action using all data from the two neighbouring layers in addition to the layer data set	

Run `divadoall` script file.

Producing a Climatology: output

An `output/3Danalysis` directory
is created and contains:

- The 4D climatology NetCDF file:
  `Temperature.19002010.4Danl.nc`
- subdirectories:
  `Fields`: contains all Diva analyses 2D-fields
  `Meshes`: contains depths meshes for each layer
- 3D NetCDF and binary (GHER format) files:
  `Temperature.19002010.nnmm.100xx.100yy.anl.nc`
  `Temperature.19002010.nnmm.100xx.100yy.fieldgher.anl`
- + 4D netcdf files (`Temperature.4Danl.nc`) if netcdf flag = 11 or -11 !

Outline

Production of a Climatology using advection fields

In `input` directory provide:

- `divadata` directory (data sets)
- `divaparam` directory
  (`coast.cont.100xx` and `param.par.100xx` files)
- `divaUVcons_all` directory which contains velocity fields:
  (GHER-format) binary files. (+ see `asctobin`)
- the `contour.depth`
- a `param.par` if not provided in `divaparam`

In `input/divaUVcons_all` provide

- `constraint.dat` (one line) file.

10	0

example: `constraint.dat` file

Production of a Climatology using advection fields

In `Climatology` directory:

- provide a `constandrefe` file:

Table 5: Example of `constandrefe` file.

advection flag
1
reference field flag
0
variable year code
00000000
variable month code
0000

- Provide `varlist`, `yearlist` and `monthlist` files.
- Edit the `driver` file and choose a flag number for analysis.
- Execute `divadoall`.

Outline

Data extraction for reference field

In `input` directory:

- the `contour.depth` file

In `Climatology` directory provide:

- `datasource` file (ODV4 spreadsheet(s) path)
- `varlist`, `yearlist` and `monthlist` files

`varlist`	`yearlist`	`monthlist`
Temperature	19002010	0103

- `qflist` file if desired
- Edit the `driver` file and choose a flag number for data extraction
- Run `divadoall` script file.

The variable(s) data set files are stored in `input/divadata` directory

Production reference fields: inputs

In `input` directory:

- `divadata` directory (data sets)
- `divaparam` directory (`coast.cont.100xx` and `param.par.100xx` files)
- the `contour.depth`
- a `param.par` if not provided in `divaparam` with value equal to zero for ireg (ireg$=0$)

In `Climatology` directory:

- Provide `varlist`, `yearlist` and `monthlist` files.
- Edit the `driver` and choose flag value 1 for data cleaning.
- and flag value 2, 21, 23 or 24 for analysis.
- Run `divadoall` script file.

Production reference fields: output

A `newinput` directory is created and contains:

- `divarefe` subdirectory which contains reference fields (Diva 2D binary files) in GHER-format.

In `output/3Danalysis` directory:

- `Fields`: contains all Diva analyses 2D-fields.
- 3D NetCDF files:

  `Temperature.19002010.0103.100xx.100yy.ref.nc`
- Binary 3D files (GHER-format):

  `Temperature.19002010.0103.100xx.100yy.fieldgher.ref`

Copy the content of `newinput/divarefe` to `input/divarefe_all`

Producing Climatology using reference fields

In `input` directory:

- `divadata` directory (data sets)
- `divaparam` (`coast.cont.100xx` and `param.par.100xx`)
- `divarefe_all` directory which contains reference fields
- the `contour.depth` file.

In `Climatology` directory:

- `constandrefe` file:

```
# advection flag
0
# reference field flag
1
# variable year code
19002010
# variable month code
0103
```

Using reference fields

In `Climatology` directory:

- `varlist`, `yearlist` and `monthlist` files
- Edit `driver` file and choose a flag number for analysis.
- Run `divadoall` script file.

Results will be stored in `output/3Danalysis` directory.

Outline

Detrending

In `input` directory provide:

- `divadata` directory where data set files have more than five columns (5th, 6th, . . . contain the information in which class the data point belongs)
- same other inputs as for normal run

In `Climatology` directory
provide the usual input text files and:

- Edit the `driver` file and
- choose a flag number for detrending a value (less or equal to the number of groups) present in your data set

Run `divadoall` script file.

- Results will be stored in

`output/3Danalysis` directory

.

To go further…

- Result layers are *stacked* together

To go further…

- Result layers are *stacked* together
- Problems may occur between two levels…

To go further…

- Result layers are *stacked* together
- Problems may occur between two levels…
- …so stabilisation is required

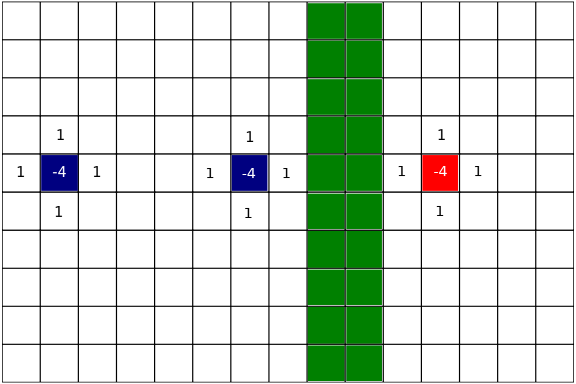
Propagation of the information I

1	-2	1			1	-2	1			1	-2	1		

- First 1D, green: land points, everything else: sea point
- Weights of the discretized Laplacian (in finite difference)
- Laplacian cannot be computed at the land boundary
- If 3 consecutive (sea) values are equal $\rightarrow$ Laplacian = 0
- Laplacian constrain (and the gradient constrain) forces that every values is close to its right and left neighbor
- This contrain is effecive everywhere except near the boundary
- The Laplacian couples directly every grid point with its two neighbors,
- Indirect coupling: two grid points that are separated by some distance as long as they are not separated by land
- The result is that value of the analysis at the two blue points must be close to each other

Propagation of the information II

- However, this is not the case of the blue points and the red point



- In two dimensions, essentially the same procedure.
- Laplacian couples the field in both spatial directions.
- DIVA works on a triangular mesh with finite elements, but this basic properties also apply