



- Diva 4.6.9
 - Any problems faced have been solved by Sylvain

Domain

- The Baltic Sea including Kattegat and parts of Skagerrak. Bounding Box: 9°E -31°E, 53°N – 66°N.
- Excluding areas outside the region (included in the North Sea/Arctic Sea region)
 - 9°E 14°E, 62°N 66°N
 - 9°E 9.4°E, 54°N 55°N
 - 9°E 10°E, 53°N 54°N

Time-space resolution

- Monthly Climatologies have been produced with data from 1900 2012. Output grids have resolution 200x200 cells, with the cell size in degrees: 0.11° in longitude, 0.065° in latitude.
- Depths: 300, 275, 250, 225, 200, 175, 150, 125, 100, 90, 80, 70, 60, 50, 40, 30, 20, 15, 10, 5, 0 (Helcom standard depths)



```
Param.par
# Lc: correlation length (in units coherent with your data), 1.# 0.7
0.7
# icoordchange (=0 if no change of coordinates is to be performed; =1 if positions are in degrees and if you want to use real
distances)#
1
# ispec: output files required, 111#
111
# ireg: mode selected for background field: 0=null guess; 1=mean of data; 2=regression plan if at least 3 non-aligned data
provided, 1#
0
# xori: x-coordinate of the first grid point of the output#
9
# yori: y-coordinate of the first grid point of the output#
53
# dx: step of output grid#
0.11
# dy: step of output grid#
0.065
# nx: number of grid points in the x-direction#
200
# ny: number of grid points in the y-direction#
200
# valex: exclusion value#
-9999.0
# snr: signal to noise ratio of the whole dataset#
1.0
# varbak: variance of the background field. If zero, no error fields are produced. If one, relative errors are obtained#
```

1.0



- We have tuned the correlation length, Lc, and signal-to-noise ratio, snr. The correlation length has been a balance to get a low enough value and not get too high errors that will mask away too much.
 - Lc = 0.7, SNR = 1.0
 - Much of the tuning has been done together with my colleague that works with DIVA for Emodnet Chemistry.
 - Estimated Lc by DIVA (for Phosphate) was between 0.4 1.1
- Four seasonal climatologies have been created and used as background fields. Seasoned defined as month: 12-02, 03-05, 06-08 and 09-11. Corresponding to winter, spring, summer and autumn.
- Clever poor man's error in DIVA has been used to calculate a relative error. This will be used to mask the climatologies where the error exceeds a set value.

Driver



```
Data extraction: 1 do it, 0 do nothing, -1 press coord, -10 pressure+Saunders
0(1)
boundary lines and coastlines generation: 0 nothing, 1: contours, 2: UV, 3: 1+2
0(1)
cleaning data on mesh: 1, 2: RL, 3: both, 4: 1 + outliers elimination, 5: =4+2
0(1)
minimal number of data in a layer. If less, uses data from any month. -1 : never uses data from other months
-1
Parameters estimation and vertical filtering:
0
Minimal L
1.4
Maximal L
10.
Minimal SN
0.1
Maximal SN
50.0
Analysis and reference field: #1 - analyse, 2 - create reference fields
1 (2)
lowerlevel number
1
upperlevel number
21
4D netcdf files generation:
1
gnuplot plots: 0 or 1
0
Data detrending: number of groups, 0 if no detrending.
0
```



Results, Salinity

- Surface Salinity, Winter (months 12, 01, 02)
 - Very similar value for salinity during each season





Results

- Surface Salinity, months 01, 04, 07, 10
 - Very similar value for salinity during each season





- Salinity, months 01 and 07, depths 0m, 20m, 50m, 70m
 - Small differences with depth, mostly in the Baltic proper*
 - No visible differences between these months (outliers removed when masked)





- Salinity is very conservative in the whole region, both in time over the year and depth.
- Varies mostly over geographic region, from low saline waters in the north of the Baltic Sea, to high saline waters in the Skagerrak



Results, Temperature

- Surface Temperature, Winter (months 12, 01, 02)
 - Temperature dropping every month during winter





- Surface Temperature, months 01, 04, 07, 10
 - Large temperature variation over the year (different scale for each season)
 - Similar values in January and April. A hint of colder water near the coast in January and probably cold water from river runoff. With the opposite in April with hints of warmer coastal water and warmer water from river runoff.
 - In July the temperature is overall high, possibly some warmer river runoff in the northern parts of the Baltic.
 - In October the cooling has begun and in the north the water has already become quite cold.
 - Some gradients in the Northern Baltic might be artifacts from DIVA due to low data coverage along the finnish coast. More visible on the masked plots.





Example of the masked plots, surface temperature in July.



Temperature, month 01 and 07, depths 0m, 20m, 50m, 70m



- Increasing temperature with depth during winter.
- Deacreasing temperature with depth during summer. (different scales)
- ~4 degrees in the Baltic proper* at 70m during both summer and winter.





- Temperature varies alot during the year in the surface layer. But is quite stable below the halocline during the whole year.
- Some geographic variation with colder in the north parts of the Baltic, and a bit warmer in Kattegat and Skagerrak.
- Possibly some artificial gradients due to lack of data, preferred to look at masked results.



Possible further work:

- Try detrending
- Try removing/weighting high density ferry box data (solid lines in map, but results are similiar at both 0m and 5m, and ferry box data is at 4m)
- More tuning of parameters Lc and SNR
- Possibly depth varying param.par (Lc and SNR)
 - Maybe using 1 param.par below halocline and one above
 - But the results seem to be ok. So using only one param.par for all depths, months, and parameters don't seem to be a big problem.
- Try plotting subregions with lower scale range, at least for salinity.





Validation

- Some checks against the old version of SDN climatologies
- Possible further validation:
 - check against World Ocean Atlas, WOA.
 - Check against Climate Atlas from IOW (covering the Baltic Sea, 1900-2005, 1x1° grids, monthly means available)



Old









Old

Masked where rel_err >50% temp_L2 2.34 Year: 19752005 Month: 0101 65°N Depth (m): 2 Lc: --Snr: --63°N 61°N 59°N 57°N 55°N 53°№ 8°E 28°E 13°E 18°E 23°E







Old

Masked where rel_err >30%











New

Old Not masked











Old

Masked where rel_err >50%









Old

Masked where rel_err >30%



2

1

0

 $^{-1}$

3

°C

5

4

6

7







Relative error of Temperature



Relative error of Temperature ()



Data Min = 0,0E+00, Max = 1,0E+00



Relative error of Temperature





Data Min = 0,0E+00, Max = 1,0E+00



Old

New







0 2 4 6 8 10 12 14 16 18 20 22 24 PSU

Old

Masked where rel_err >50%







Old

Masked where rel_err >30%











Old











Old

Masked where rel_err >50%







Old

Masked where rel_err >30%









Relative error of Salinity









Relative error of Salinity





Data Min = 0,0E+00, Max = 1,0E+00



- Does not look like it's 30% (0.3) that was used to mask the data field, more like 10% (0.1) for L1 (L2 probably 5%)
- Likely a large underestimation of the error, old poor man's error?

