

# EMODnet Chemistry 3 Technical Working Group

OceanBrowser

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GHER-ULg  
Deltares



# DIVA: Data Interpolating Variational Analysis

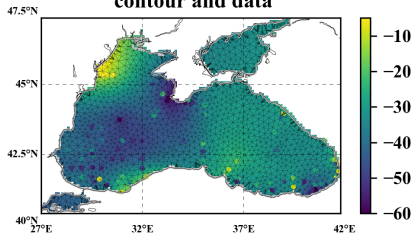
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**Method:** variational inverse method: derive continuous field

**Analyzed field, mesh,  
contour and data**



*close to the observations*

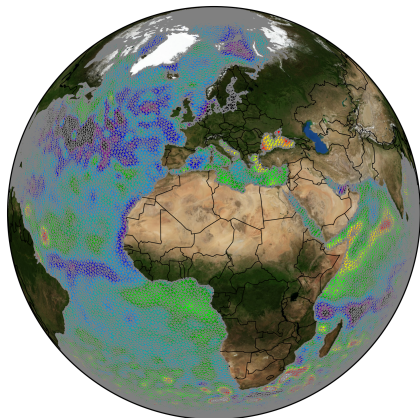
*smooth / regular*

# DIVA: Data Interpolating Variational Analysis

**Objective:** derive gridded fields from in situ observations

**Method:** variational inverse method: derive continuous field

**Solver:** finite-element mesh



decouples basins based on topography

can take ocean currents into account

can detect trends in the data

can detect and remove outliers

consistent error variance estimation

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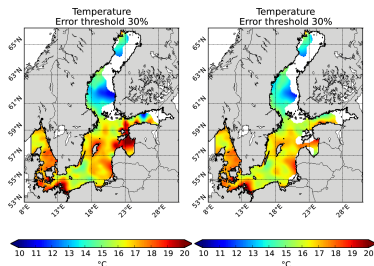
**Solver:** finite-element mesh

**Code:** switched from SVN to github:

[www.github.com/gher-ulg/DIVA](http://www.github.com/gher-ulg/DIVA) (+ DOI for each release)

# Recent developments: mainly user-driven

1. Data **weighting** decrease the weight of close-by observations in the analysis  
(necessary for time series)



Weights based on space and time distance

SST analyses over the Baltic Sea without (left) and with (right) data weighting.

In situ data over July 1900-2012

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V.4.6.11

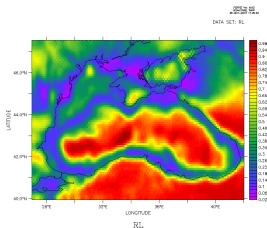
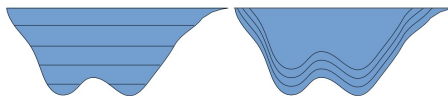


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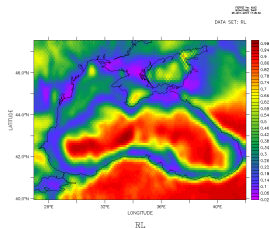
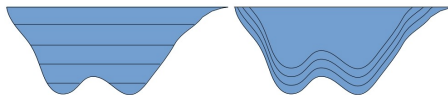
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6. Variable correlation length depending on the gradient of the depth for bottom analyses V.4.7.1
7. Conversion of **EMODnet bathymetry** to DIVA-readable forma V.4.7.1

# OceanBrowser: a web-interface to visualize gridded products

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EMODnet portal:

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- ▶ Scalar and vector fields

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## Features:

- ▶ Horizontal and vertical sections
- ▶ Scalar and vector fields

## Uses:

Visualisation of DIVA products in:

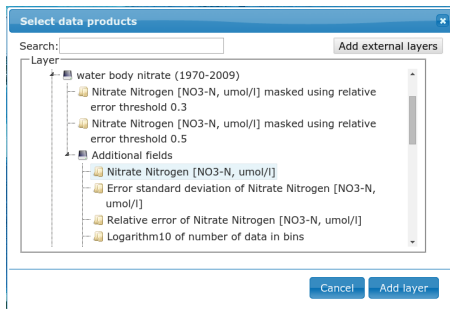
- ▶ SeaDataNet - SeaDataCloud
- ▶ EMODnet Chemistry



# Present features

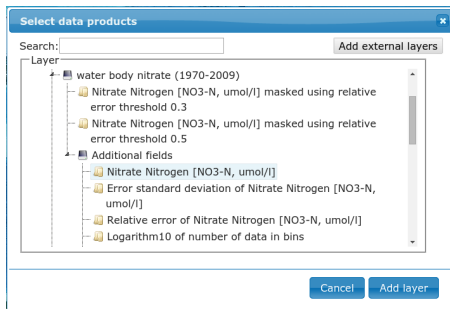
# Layer selection

- ▶ Simple directory structure on the server mapped into a hierarchical list of layers
- ▶ NetCDF files added on-the-fly (no server restart)
- ▶ Virtual sub-folders can be added to hide/highlight some variables



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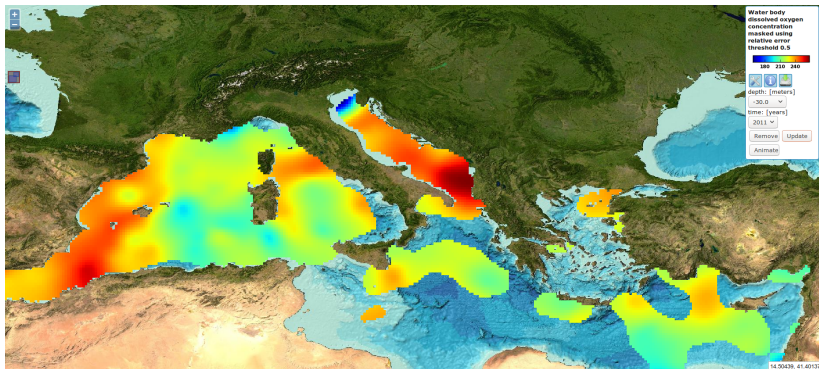


For DIVA fields:

- 1st level:** analysis masked by an error threshold
- 2nd level:** full field available under "Additional fields"

# Horizontal section

Right panel: controls current layer

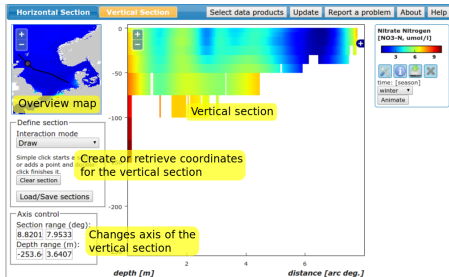


- ▶ Select depth and time
- ▶ Plot style
- ▶ Metadata
- ▶ Download of data product

# Vertical section

## User interface

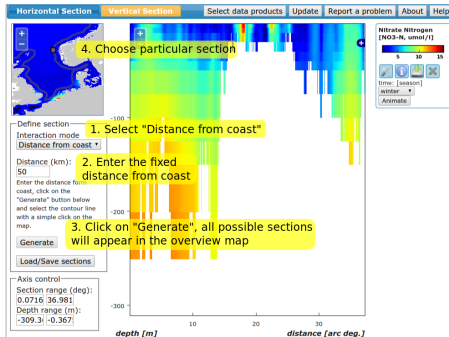
- ▶ Vertical section drawn with the mouse
- ▶ Data product extracted along this section
- ▶ Section coordinates can be saved (to visualize two parameters exactly along the same section)



# Vertical section

The path of a vertical section can be generated automatically by:

- ▶ Fixed distance from coast or
- ▶ fixed ocean depth



# Data product download

**Download layer** ✕

**Data products:**

?

**Image/Animation:**

Width (px):	<input type="text" value="800"/>	Height (px):	<input type="text" value="500"/>
x-range:	<input type="text" value="-4.319"/> <input type="text" value="31.891"/>	y-range:	<input type="text" value="29.695"/> <input type="text" value="51.316"/>
Format:	<input type="text" value="PNG"/> ▼	<input type="button" value="Download"/>	

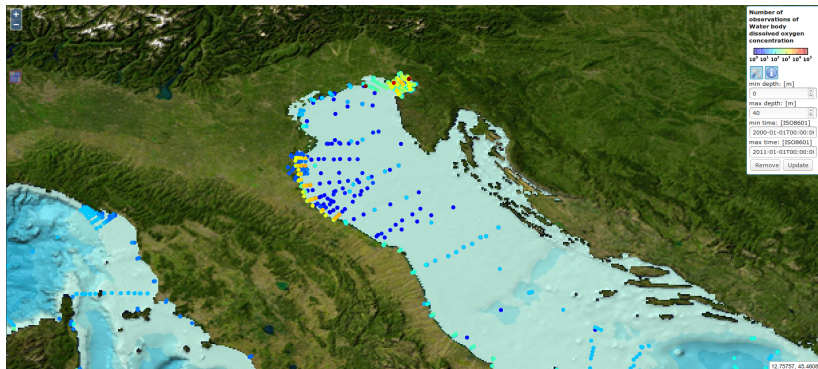
The creation of animation (WebM or MP4) may take several minutes.

- ▶ NetCDF or OPeNDAP protocol
- ▶ Images or animations

# Observation location: WFS / WPS

Web Feature/ Processing Service

Deltares



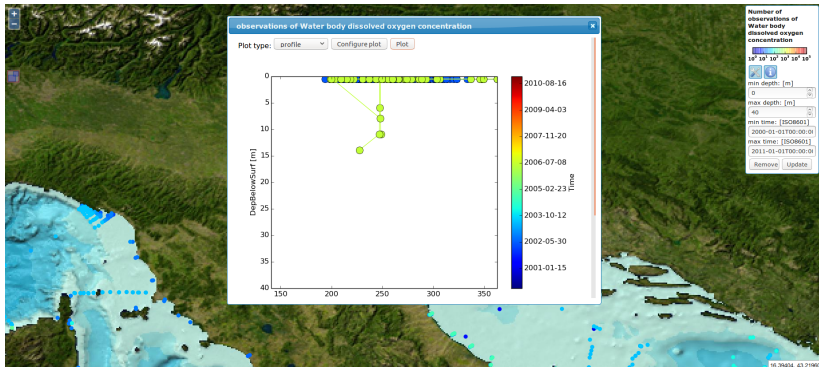
Before: **WFS** → location of every observation ( $10^4 - 10^5$ )

Now: **WPS** → image with the observation location



# Dynamic plots

## Profiles



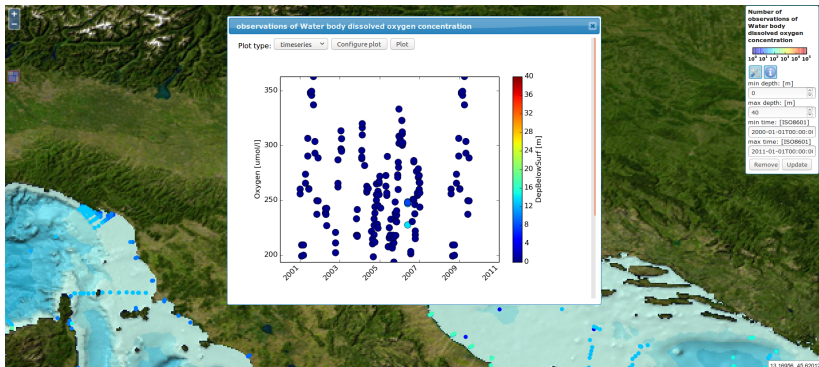
x: field value

y: depth

color: time

# Dynamic plots

## Time series



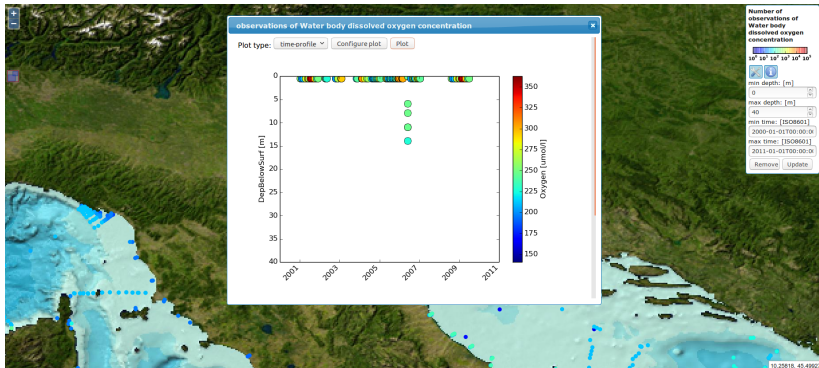
x: time

y: field value

color: depth

# Dynamic plots

## Time section



x: time

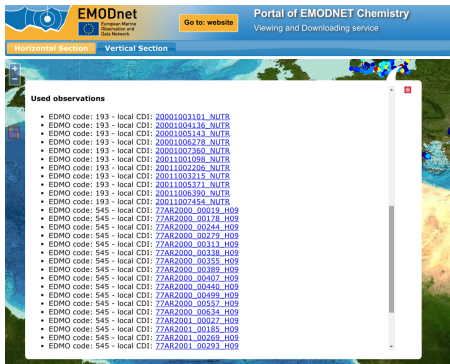
y: depth

color: field value

# List of all observations

Observations in SeaData{Net,Cloud} and EMODnet Chemistry identified by:

- ▶ EDMO code: institution
- ▶ CDI: identifier
- ▶ For each plot: list of all used observations + link to central repository



The screenshot shows the EMODnet Portal of EMODNET Chemistry. The page has a blue header with the EMODnet logo and the text "EMODnet European Marine Observation and Data Network". There is a "Go to: website" button and the text "Portal of EMODNET Chemistry Viewing and Downloading service". Below the header, there are two tabs: "Horizontal Section" and "Vertical Section". The main content area shows a map of the ocean with a white box overlaying it. The box is titled "Used observations" and contains a list of 30 entries, each with an EDMO code, institution, and CDI identifier. The list is as follows:

- EDMO code: 193 - local CDI: [20001003101\\_NUTR](#)
- EDMO code: 193 - local CDI: [200010041136\\_NUTR](#)
- EDMO code: 193 - local CDI: [20001005143\\_NUTR](#)
- EDMO code: 193 - local CDI: [20001006278\\_NUTR](#)
- EDMO code: 193 - local CDI: [20001007360\\_NUTR](#)
- EDMO code: 193 - local CDI: [20011001098\\_NUTR](#)
- EDMO code: 193 - local CDI: [20011002206\\_NUTR](#)
- EDMO code: 193 - local CDI: [20011003215\\_NUTR](#)
- EDMO code: 193 - local CDI: [20011005371\\_NUTR](#)
- EDMO code: 193 - local CDI: [20011006390\\_NUTR](#)
- EDMO code: 193 - local CDI: [20011007454\\_NUTR](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00019\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00178\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00244\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00279\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00313\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00338\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00355\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00389\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00407\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00440\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00499\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00557\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2000\\_00634\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2001\\_00077\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2001\\_00185\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2001\\_00269\\_HO9](#)
- EDMO code: 545 - local CDI: [77AR2001\\_00293\\_HO9](#)

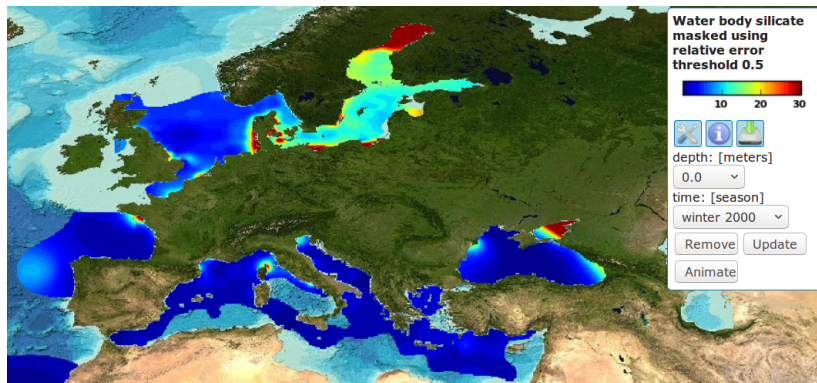
# Recent developments

# Combined European product

**Origin:** analyses performed by EMODnet partners

**Features:** all seasons, several depths, 5 variables

**Boundaries:** smooth filter to ensure continuity



Work in  
progress

# DIVAnd: N-dimensional version of DIVA

- *Old* DIVA: 2-dimensional analysis

longitude, latitude



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- Present version: Julia language
  - huge improvement

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  - ▶ Climatologies
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Code: available from 

[www.github.com/gher-ulg/divand.jl](https://www.github.com/gher-ulg/divand.jl)

# Jupyter notebooks as a user interface

Notebook = interactive environment combining:

- ▶ Text
- ▶ Code fragments
- ▶ Images / animations
- ▶ Equations

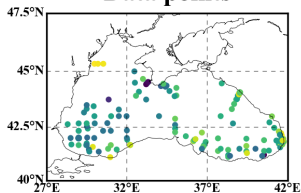
## Data points

We use the function `add_to_plot` with 'm' (the projection) as an optional argument.

```
In [18]: fig = plt.figure(figsize=(2, 2))
Data.add_to_plot(m=m, s=3)
m.drawmeridians(np.linspace(Param.xor1, Param.xend, 4), labels=[0, 0, 0, 1], linewidth=0.2, fontsize=6)
m.drawparallels(np.linspace(Param.yor1, Param.yend, 4), labels=[1, 0, 0, 0], linewidth=0.2, fontsize=6)
m.drawcoastlines(linewidth=0.2)
plt.title('Data points')
plt.savefig(os.path.join(figdir, 'datapoints.png'))
plt.show()
plt.close()

/usr/local/lib/python3.6/site-packages/matplotlib/backends/_backend.py:3222: MatplotlibDeprecationWarning: The ishold function was deprecated in version 2.0.
  b = ax.ishold()
/usr/local/lib/python3.6/site-packages/matplotlib/backends/_backend.py:3231: MatplotlibDeprecationWarning: axes.hold is deprecated.
  See the API changes document (http://matplotlib.org/api/api\_changes.html)
  for more details.
ax.hold(b)
```

## Data points



# Summary & conclusions

## 1. **Visualization** of gridded data sets:

along a horizontal section

along a vertical section

(given time and depth)

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Image export (PNG, EPS, SVG, ...)  
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## 6. **Innovative** developments in spatial interpolation methods

(Almost) all the developments available in



[www.github.com/gher-ulg](https://www.github.com/gher-ulg)