SeaDataNet 2 Kick-Off Meeting

Planned Upgrading of Diva software

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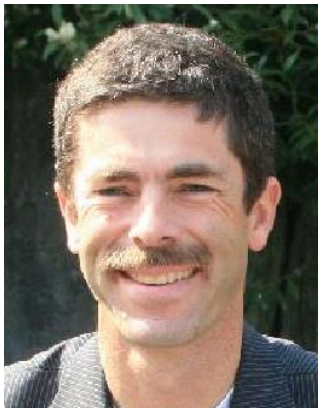
October 20, 2011

The GHER DIVA team

Alexander
web services
code development



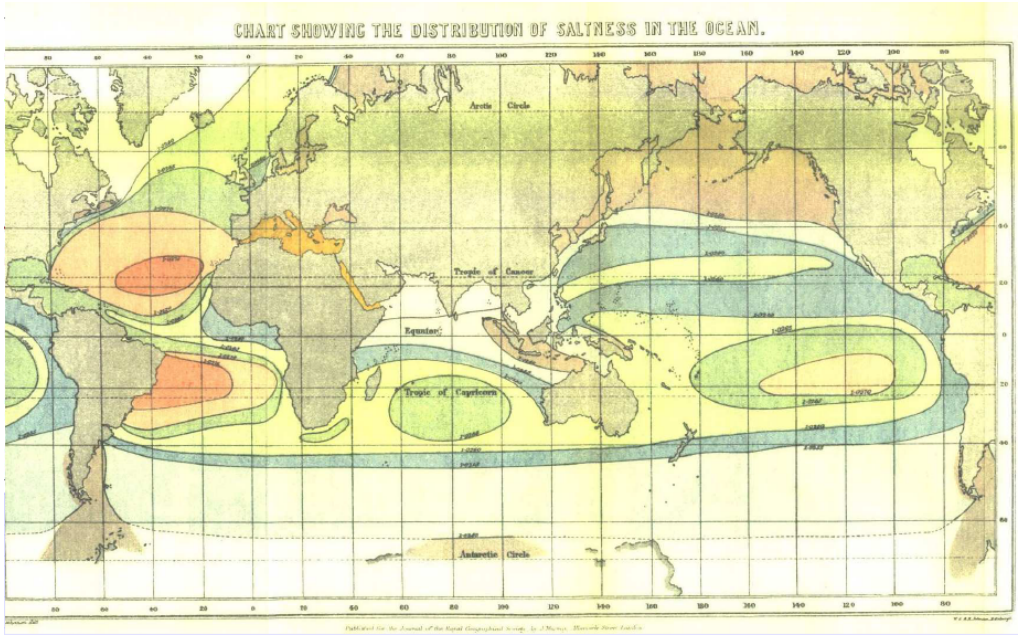
Jean-Marie
the boss

Mohamed
code development
& testing

Charles
user manual
workshop

The Diva tool

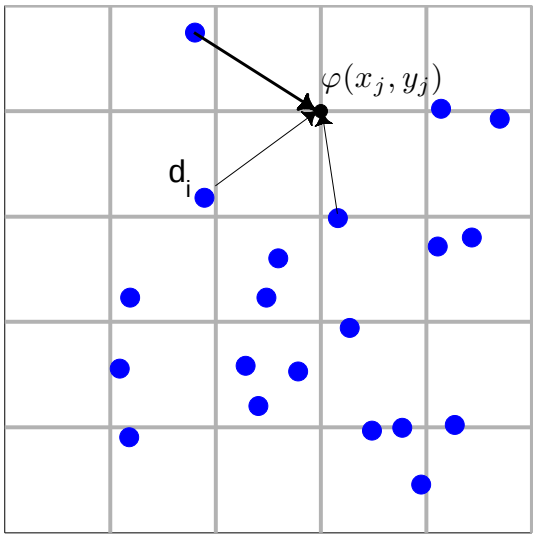
- Motivation: sparse and heterogeneously distributed data
- Objective: creation of a climatology or hydrographic atlas



- Applications:
  - consistency of measurements
  - initialisation, calibration, validation of models
  - analyses of changes and trends
  - budget analyses

DIVA = Data-Interpolating Variational Analysis

From N_d data d_i •
Construct field $\varphi(x_j, y_j)$



Formulation: minimize cost function J

$$\min J[\varphi] = \sum_{i=1}^{N} \mu_i \left[d_i - \varphi(x_i, y_i)\right]^2 + \int_D \left(\boldsymbol{\nabla}\boldsymbol{\nabla}\varphi : \boldsymbol{\nabla}\boldsymbol{\nabla}\varphi + \alpha_1 \boldsymbol{\nabla}\varphi \cdot \boldsymbol{\nabla}\varphi + \alpha_0 \varphi^2\right) \mathrm{d}D$$

μ_i = data weights
$\boldsymbol{\nabla}$ = gradient operator
$\alpha_\imath$ = coefficients to determine

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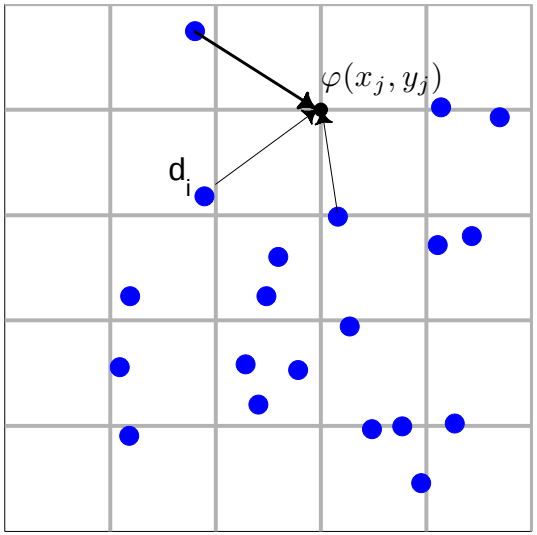


Formulation: minimize cost function J

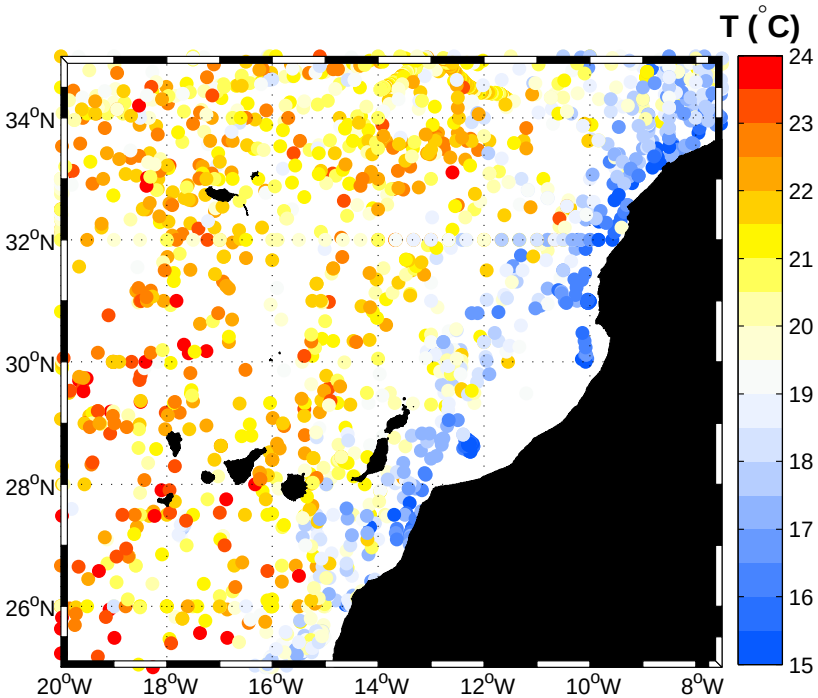
$$\min J[\varphi]$$

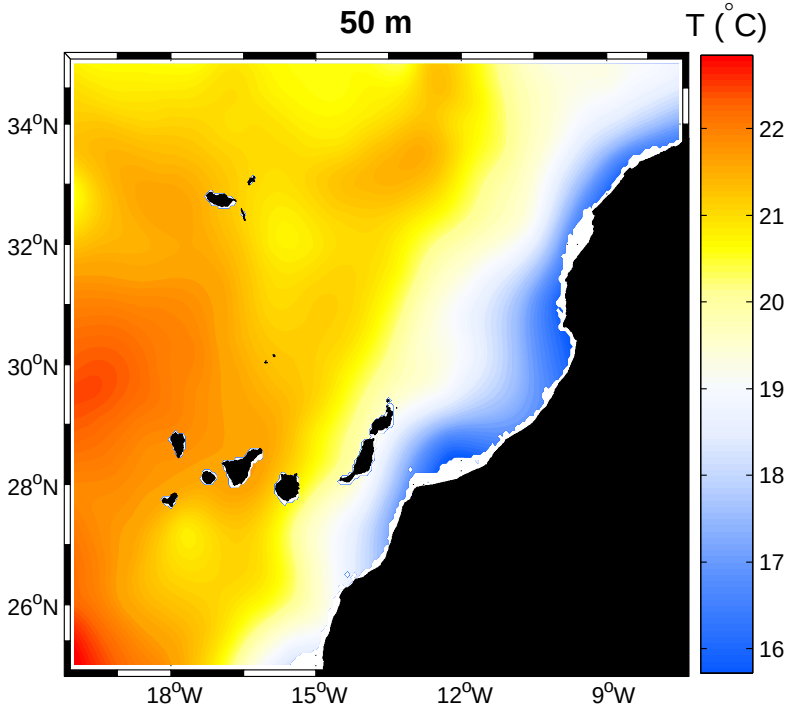
$$= \sum_{i=1}^{N} \mu_i \underbrace{[d_i - \varphi(x_i, y_i)]^2}_{\text{difference between data and analysis}}$$

$$+ \underbrace{\int_D \left(\boldsymbol{\nabla}\boldsymbol{\nabla}\varphi : \boldsymbol{\nabla}\boldsymbol{\nabla}\varphi + \alpha_1 \boldsymbol{\nabla}\varphi \cdot \boldsymbol{\nabla}\varphi + \alpha_0 \varphi^2\right) \mathrm{d}D}_{\text{shape + regularity of the field}}$$

μ_i = data weights
$\boldsymbol{\nabla}$ = gradient operator
α_i = coefficients to determine

From in situ data to gridded fields





Planned developments

1. **Modernisation of the code** D9.9
2. Multivariate approach
3. Non-Gaussian variables
4. Benefit of 4-D analysis (prototype) D9.10
5. Impact of spatially correlated observation errors D9.10

Fortran 95: dynamic memory allocation

New solver: large matrix ($> 10^7$ observations) calculations
parallel implementation (ODV users)

Optimisation of input reading:
large arrays
NetCDF format
moving platforms (compatibility with ODV)

Planned developments

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Two (or more) variables are analysed together

- consideration of the relationship between variables
- improvement of the analysis

Examples

Temperature and chlorophyll a concentration

River plumes: salinity and biochemical parameters

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Problems: negative concentration, overshoots

Solution: non-linear data transformation (anamorphosis)
Error field?

Planned developments

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Now: 4-D = stacking of horizontal layers (depth and time)

Next: Benefit of working with n dimensions

- Moving observation platforms (gliders)
- Vertical constraints: advection, mixing

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Problems: climatologies biased by data distribution
estimation of parameters by cross-validation

Solutions: detrending
explicit correlated observation error (costly algorithm!)
consideration of data redundancy (error inflation, binning)

Planned developments

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Rules:

- ✓ Backward compatibility/ portability
- ✓ Independence on proprietary software
- ✓ User-driven developments

GHER-Diva server: http://gher-diva.phys.ulg.ac.be/

Data-Interpolating Variational Analysis (Diva)

Diva

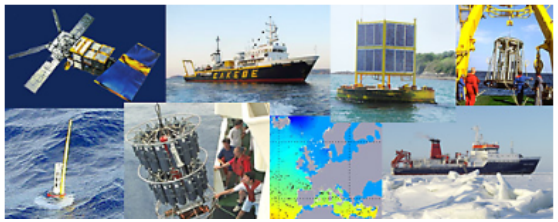
Spatial interpolation of observations on a regular grid is a common task in many oceanographic disciplines (and geosciences in general). It is often used to create climatological maps for physical, biological or chemical parameters representing e.g. monthly or seasonally averaged fields. Since instantaneous observations can not be directly related to a field representing an average, simple spatial interpolation of observations is in general not acceptable. Diva (Data-Interpolating Variational Analysis) is an analysis tool which takes the error in the observations and the typical spatial scale of the underlying field into account. Barriers due to the coastline and the topography in general and also currents estimates (if available) are used to propagate the information of a given observation spatially.

Access the web-interface of Diva

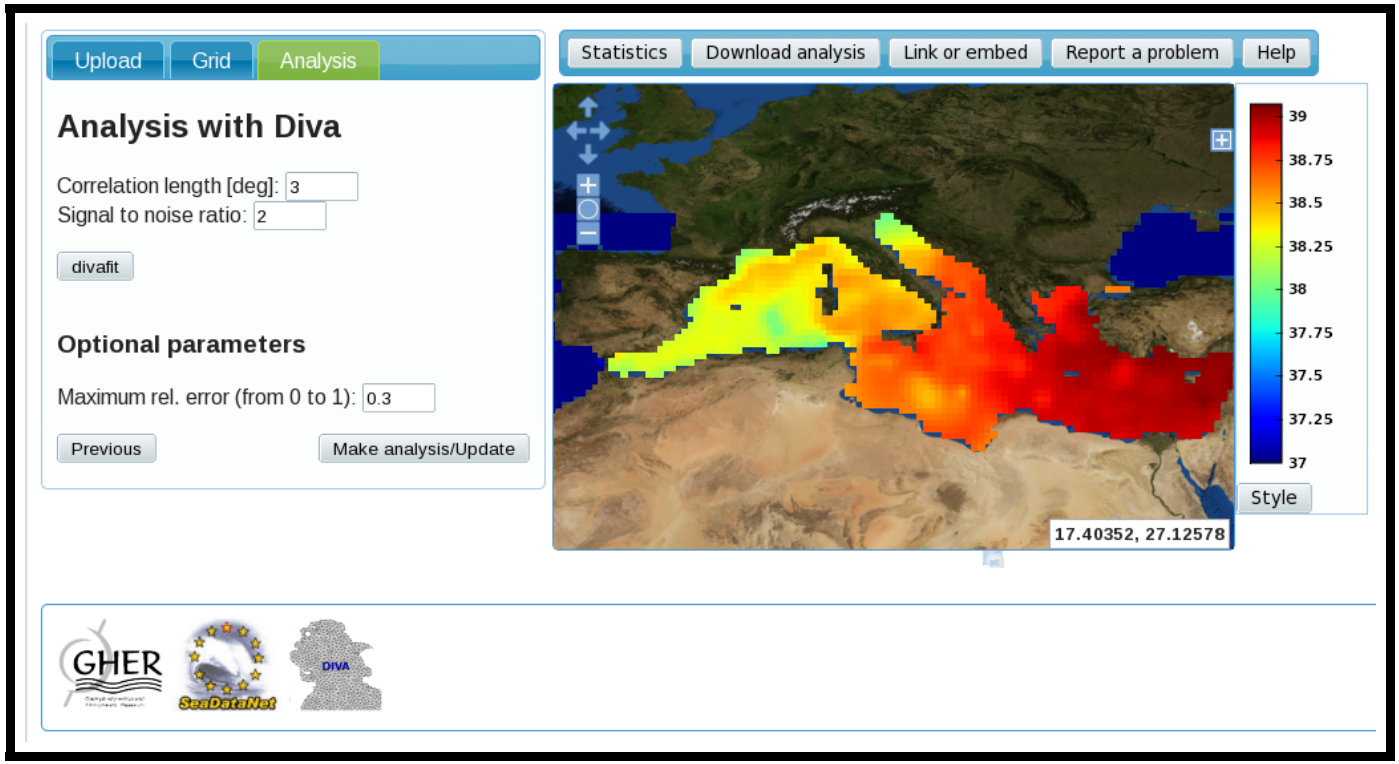
Diva Four-Dimensional Analysis

Diva 4D Climatology Building software, based on Diva analysis system, allows creating climatologies as four dimensional analysis netcdf files. It uses input data from ODV4 spread-sheets for a given set of variables and climatology time information. A climatology netcdf files for a variable contains the diva analysis of the variable and a set of variable related information fields: relative error and error standard deviation fields, variable masked (using two relative error thresholds) fields, deepest values of the variable field and the related masked fields. It contains also fields of information about data distribution and outliers as well as fields of correlation length and signal to noise ratio parameters.

Access the web-visualisation of climatologies



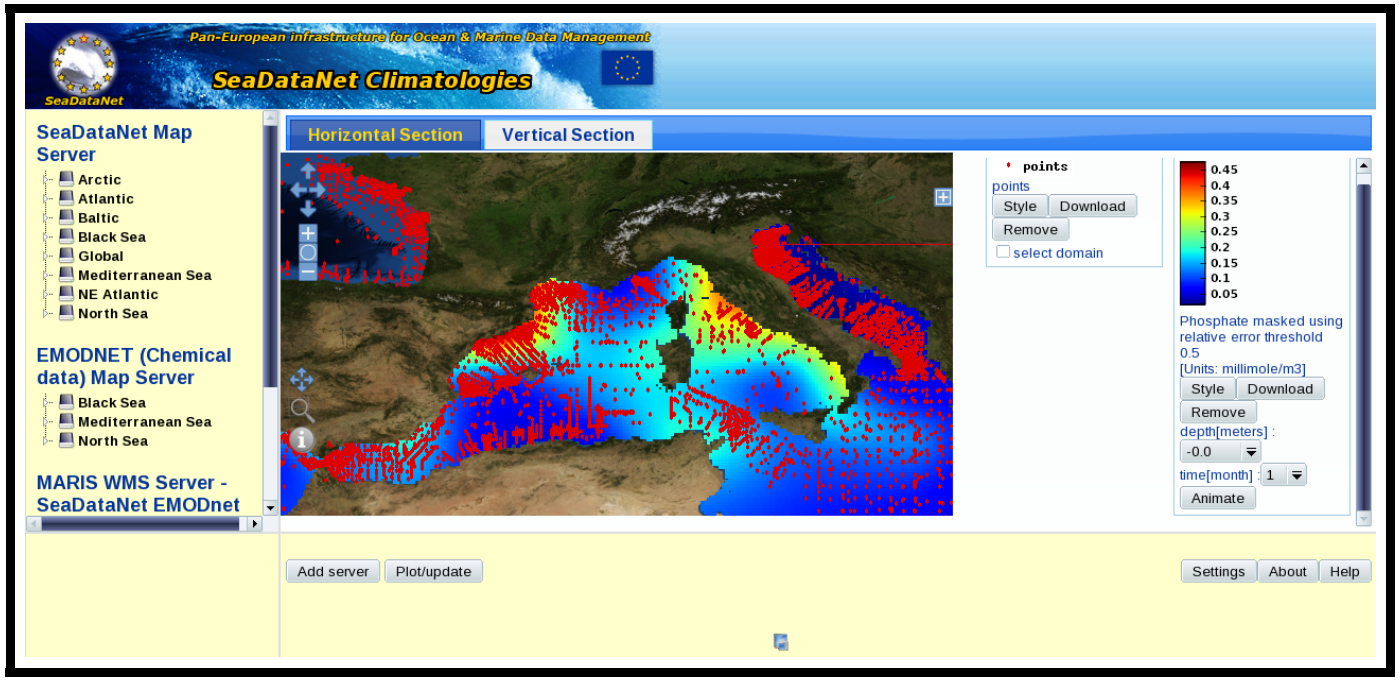
Diva-on-web: 2-D analysis from a web browser



Improvements: D9.11

- additional metadata in the NetCDF files
- advection constraint

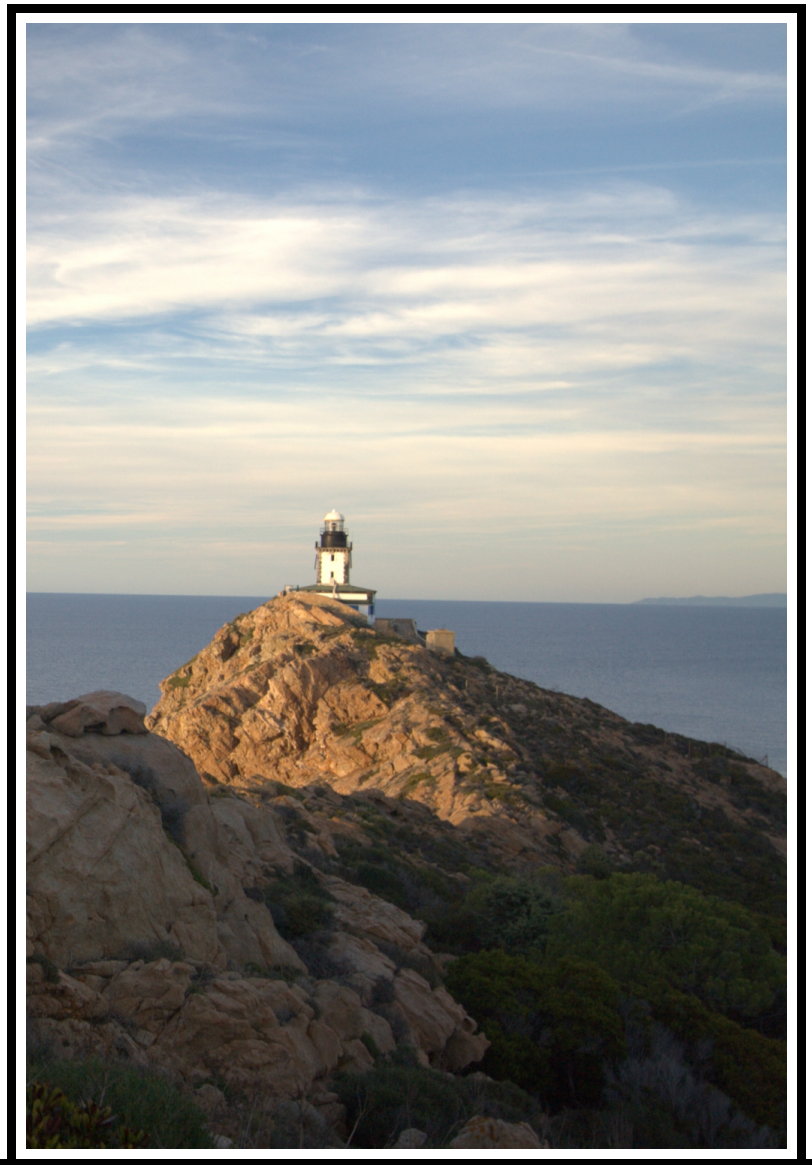
OceanBrowser: visualisation of climatologies (OGC standards)



Improvements: D9.12

- Improved caching mechanism / decrease time of access
- Improved user-interactions (metadata access)
- Inclusion of external WMS layers
- Improved animation support (time range and download)

Diva user workshop



Where? STARESO station

When? Early May 2012?

Public: beginners, intermediate and expert users

How? Contact me
ctroupin@ulg.ac.be

Thanks for your attention

http://modb.oce.ulg.ac.be/
http://gher-diva.phys.ulg.ac.be/