Data-Interpolating Variational Analysis (Diva) software, a tool for European regional seas and Ocean climatologies production

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Diva & SeaDataNet

Data-Interpolating Variational Analysis (Diva) is a software based on a method designed to perform data-gridding (or analysis) tasks, with the assets of taking into account the intrinsic nature of oceanographic data, i.e., the uncertainty on the in situ measurements and the anisotropy due to advection and irregular coastlines and topography. The Variational Inverse Method (VIM, Brasseur et al., 1996) implemented in Diva consists in minimizing a variational principle which accounts for the differences between the observations and the reconstructed field, the influence of the gradients and variability of the reconstructed field. The resolution of the numerical problem is based on finite-element method, which allows a great numerical efficiency and the consideration of complicated contours. Along with the analysis, Diva provides also error fields (Brankart and Brasseur, 1998; Rixen et al., 2000) based on the data coverage and noise.

Diva is used for the production of climatologies in the pan−European network SeaDataNet. SeaDataNet is connecting the existing marine data centres of more than 30 countries and set up a data management infrastructure consisting of a standardized distributed system. The consortium has elaborated integrated products, using common procedures and methods. Among these, it uses the Diva software as reference tool for climatologies computation for various European regional seas, the Atlantic and the global ocean.

Outliers eliminattion

Diva offers the possibility of detection and elimination of possible outliers when producing four dimentional climatologies.

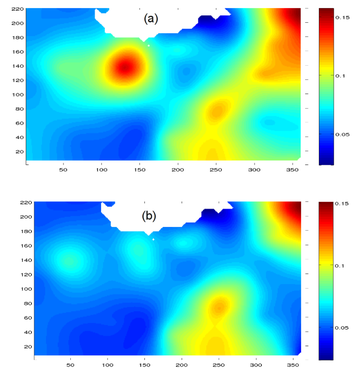


Figure 1: Surface layer Phosphates climatology, (a) without outliers elimination, (b) with outliers elimination.

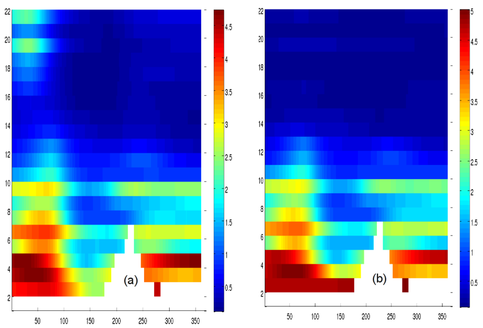


Figure 2: Vertical section of Nitrates climatology, (a) without outliers elimination, (b) with outliers elimination.

Vertical coherence

Four dimentional climatologies produced with Diva are based on gathering the two dimensional analyses. To ensure a vertical coherence of the analyses, correlation length and signal to noise parameters can be optimised and vertically filtered. For more vertical coherence, Diva offers the possibility to filter the backgroud mean field, or use semi normed reference fields generated by merging data sets of neighbourhood layers.

Figure 3: Using semi normed reference field based on merging data sets from three neighbourhood layers, (a) without, (b) with. Filtering mean backgroud: (c) with.

Diva features

During the first phase of the SeaDataNet project, a number of additional tools were developed to make easier the climatologies production:

- creation of contours files at selected depths;
- signal-to-noise ratio determination through Generalized Cross Validation;
- detection and elimination of outliers;
- advection constraint
- hydrostatic constraint (elimination of hydrostatic instabilities in temperature and salinity data sets);
- variable correlation length ;
- computation of the error ;
- semi-normed reference fields.

Unrealistic values elimination

When data have a "pronounced" non-gaussian distribution, numerical calculations of the analyses may lead to unrealistic and/or negative values for concentrations. To help avoiding it, Diva performs analyses based on transformed data:

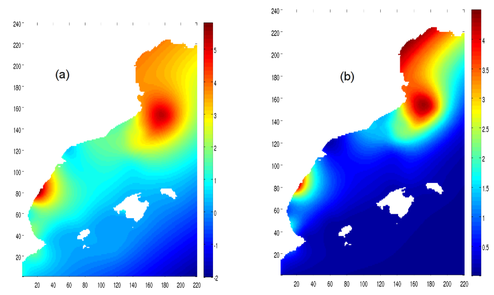
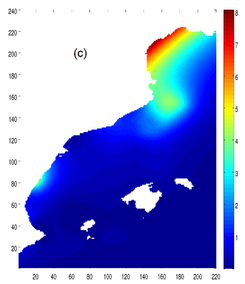


Figure 5: Nitrates analyses, (a) without transformation, (b) with anamorphosis transformation, (c) with $\log(data) - \exp(analysis)$ *transformation*



Diva tools

Collaboration with Diva users (marine data centres) permitted the identification of a variety of problems that can occur in the Diva analysis due to numerical computations and/or data types (i.e. negative concentrations for certain data sets of biochemical and nutrient data). To solve these problems, new options were designed and implemented additional for Diva computation algorithms. Among these new options the user has the possibility to:

- avoid negative values performing analyses based on transformed data (i.e. anamorphosis transformation),
- avoid unrealistic and/or negative concentrations due to small number of data using semi-normed reference field generated with data sets from other layers, to perform a layer analysis,
- filter vertically the background (mean data) or reference fields for vertical field coherence.

References

The complete list of papers can be found at `http://modb.oce.ulg.ac.be/mediawiki/index.php/Diva_publications`

Recent publications

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Acknowledgments

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