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Data-Interpolating Variational Analysis (DIVA) software : recent development and application

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The Data-Interpolating Variational Analysis (DIVA) software is a tool designed to reconstruct a continuous field from discrete measurements. This method is based on the numerical implementation of the Variational Inverse Model (VIM), which consists of a minimization of a cost function, allowing the choice of the analysed field fitting at best the data sets. The problem is solved efficiently using a finite-element method. This statistical method is particularly suited to deal with irregularly-spaced observations, producing outputs on a regular grid.

Initially created to work in a two-dimensional way, the software is now able to handle 3D or even 4D analysis, in order to easily produce ocean climatologies. These analyses can easily be improved by taking advantage of the DIVA's ability to take topographic and dynamic constraints into account (coastal relief, prevailing wind impacting the advection,...).

DIVA is an open-source software which is continuously upgraded and distributed for free through frequent version releases. The development is funded by the EMODnet and SeaDataNet projects and include many discussions and feedback from the users community. Here, we present two recent major upgrades : the data weighting option and the bottom-based analyses.

Since DIVA works with a diagonal observation error covariance matrix, it is assumed that the observation errors are uncorrelated in space and time. In practice, this assumption is not always valid especially when dealing e.g. with cruise measurements (same instrument) or with time series at a fixed geographic point (representativity error). The data weighting option proposes to decrease the weights in the analysis of such observations. Theses weights are based on an exponential function using a 3D (x,y,t) distance between several observations. A comparison between not-weighted and weighted analyses will be shown.

It has been a recurrent request from the DIVA users to improve the way the analyses near the ocean bottom are produced. Up to now, the analyses were performed at several depths counted from the ocean surface, meaning that horizontal layers were used for the analyses, and then combined in a “deepest variable” field using for each grid point the deepest result available. Although simple, this former method had two significant drawbacks. Firstly, some layers close to the bottom become divided in many patches, leading to an underestimated propagation of the information. Secondly, many applications require a fixed distance from the ocean bottom. In the last DIVA version, a new feature allows the computation of the layers from several user-defined distances from the bottom surface. This new method includes a methodology aiming to minimize the error on the value of the bottom depth.