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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 analyzed 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 analyzes 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,...).

In DIVA, we assume errors on measurements are not correlated, which means we do not consider the effect of correlated observation errors on the analysis and we therefore use a diagonal observation error covariance matrix. However, the oceanographic data sets are generally clustered in space and time, thus introducing some correlation between observations. In order to determine the impact of such an approximation and provide strategies to mitigate its effects, we conducted several synthetic experiments with known correlation structure. Overall, the best results were obtained with a variant of the covariance inflation method.

Finally, a new application of DIVA on satellite altimetry data will be presented : these data have particular space and time distributions, as they consist of repeated tracks ($\sim$10-35 days) of measurements with a distance lower than 10 km between two successive measurements in a given track. The tools designed to determine the analysis parameters were adapted to these specificities. Moreover, different weights were applied to measurements in order to take the different times of measurements into account. This application focused on daily fields of sea level anomalies in the Mediterranean Sea.