

# Comparison between Optimal Interpolation (OI) and Data-Interpolating Variational Analysis (Diva) for the generation of analysis and error gridded fields

C. Troupin<sup>(1)</sup>, M. Ouberdous<sup>(1)</sup>, A. Barth<sup>(1)</sup>, A. Alvera-Azcárate<sup>(1)</sup>, D. Sirjacobs<sup>(2)</sup> & J.-M. Beckers<sup>(1)</sup>

## ABSTRACT

**Optimal Interpolation (OI)** is one of the most popular method. It is based on the minimization of the expected error variance.

**The assets:** the ease of use and the error field generated along with the analysis.

**The drawbacks:** the numerical cost and the quality of the results when the number of data is not sufficient or when the covariances are not correctly specified.

**Data Interpolating Variational Analysis (Diva)** is an alternative to OI. It is based on the minimization of a cost function measuring the data-analysis misfit and the regularity of the reconstructed field, through a finite-element solver.

**The assets:** it allows the consideration of anisotropies and decorrelations introduced by coastlines or frontal structures.

**The drawbacks:** the apparent complexity of the method.

In this work we compare the analysis and error fields provided by the two methods.

## DATA

We work with salinity measurements in the Mediterranean Sea at a depth of 30 m in July, for the 1980-1990 period.

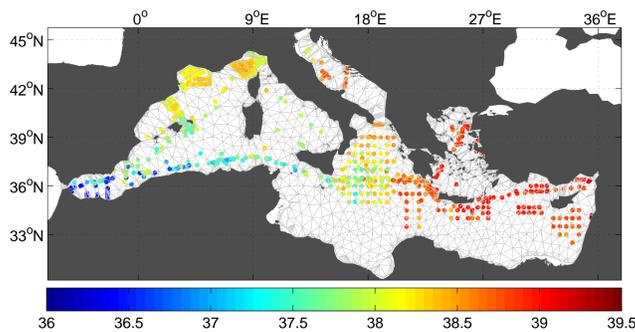


Figure 1: Finite-element mesh and salinity measurements used for the application.

## ANALYSIS

Once the analysis parameters are set, the gridded field is obtained. We observe the characteristic zonal gradient of salinity, with the lowest values in the Alboran Sea.

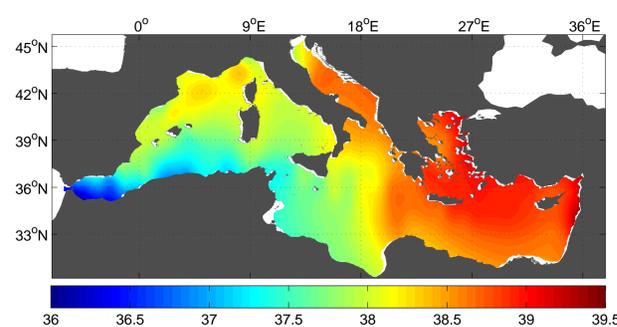
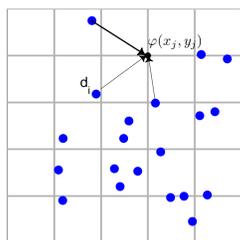


Figure 2: Salinity field obtained with  $L = 1.42^\circ$  and  $\lambda = 1$ .

## METHOD

The principle of Diva is to find an analysis field  $\varphi$  that satisfies a set of constraints over a domain  $\Omega$ , expressed in the form of a cost function. This cost function is made up of:



1. the distance between analysis and data (*observation constraint*),
2. the regularity of the analysis (*smoothness constraint*),
3. physical laws (*behaviour constraint*).

## COMPARISON WITH OI

The differences with respect to OI are especially visible near the Italian coasts, since with OI, the effects of the physical boundary is not taken into account.

Away from the coasts, the RMS of the difference between the fields is lower than 0.02.

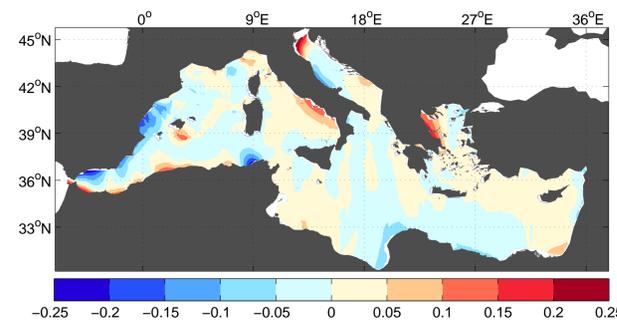


Figure 3: Difference between OI and Diva salinity fields obtained with  $L = 1.42^\circ$  and  $\lambda = 1$

## ERROR FIELDS

The error field is computed with different methods and provide fields similar to that of OI, except for the poor man's estimate, which underestimates the error. As expected, we obtain high errors in regions void of data (see Figure 1). The advantage of the poor man's estimate is its low computational cost. With more numerical operations, the other methods provide a more consistent error field.

The novelty is the estimation of the real covariance, which is never parameterized explicitly in Diva. It is estimated using two simultaneous Diva executions.

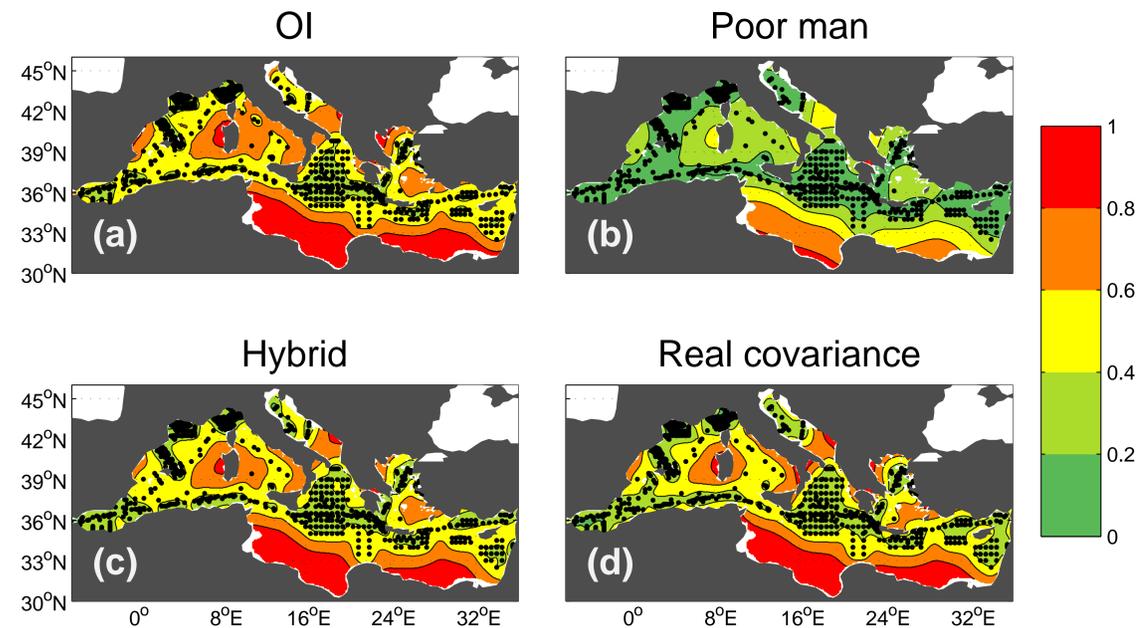


Figure 4: Error fields computed using four different methods: (a) OI, (b) poor man's estimate, (c) hybrid and (d) real covariance methods.

## REFERENCES

The complete list of papers can be found at [http://modb.oce.ulg.ac.be/mediawiki/index.php/Diva\\_publications](http://modb.oce.ulg.ac.be/mediawiki/index.php/Diva_publications)

## Recent publications

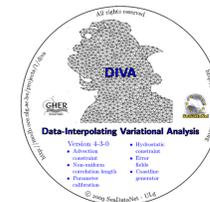
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## HOW TO GET THE CODES

The code is distributed under the terms of the GNU General Public License (GPL). It is available at [http://modb.oce.ulg.ac.be/mediawiki/index.php/DIVA#How\\_to\\_get\\_the\\_code.3F](http://modb.oce.ulg.ac.be/mediawiki/index.php/DIVA#How_to_get_the_code.3F) or by scanning the QR-code.



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<sup>(1)</sup> GeoHydrodynamics and Environment Research, MARE, Department AGO, University of Liège, BELGIUM  
<sup>(2)</sup> Algology, Mycology and Experimental Systematics, Department of Life Sciences, University of Liège, BELGIUM