Data Interpolating Empirical Orthogonal Functions (DINEOF): a tool for geophysical data analyses

Alvera Aida, *GHER-ULG, A.Alvera@ulg.ac.be, (Belgium)*
A. Barth, *GHER-ULG, abarth@ulg.ac.be*
D. Sirjacobs, *GHER-ULG, D.Sirjacobs@ulg.ac.be*
J.M. Beckers, *GHER-ULG, JM.Beckers@ulg.ac.be*

Geophysical data sets, such as those obtained from satellites, often contain gaps (missing values) due to the presence of clouds, rain, or simply due to incomplete track coverage. There is a rising need, however, for complete data sets at the global, regional and local scale: several analysis methods, input for hydrodynamic models and data visualization are examples of applications where complete data sets are preferred or even necessary.

DINEOF (Data Interpolating Empirical Orthogonal Functions) is a method to reconstruct missing data in geophysical data sets (Beckers and Rixen, 2003). Based on Empirical Orthogonal Functions (EOFs), DINEOF uses an iterative procedure to calculate the values at the missing locations. DINEOF has been compared to Optimal Interpolation (OI), demonstrating that more accurate results are achieved, with up to 30 times less computational time (Alvera-Azcárate et al, 2005). Another advantage of DINEOF is that there is no need for a priori knowledge of the statistics of the reconstructed data set (such as covariance or correlation length).

DINEOF is able to reconstruct missing data in univariate data sets (e.g. sea surface temperature (SST) or chlorophyll). The multivariate application of DINEOF is also straightforward, using multivariate EOFs containing several variables with the possibility of including also different time lags (Alvera-Azcárate et al, 2007). A multivariate DINEOF takes into account the inter-relationships between related variables (such as SST and chlorophyll) to infer data at the missing locations. As more data is introduced for the reconstruction, the accuracy of the results can be larger than for the univariate application of DINEOF.

Spatial maps of the reconstruction error covariance estimation are also calculated with DINEOF. Using the EOFs as background error covariance, this approach was successfully applied to the Ligurian Sea (Beckers et al, 2006) showing that the error maps obtained reflect the initial cloud coverage and the covariances of the physical fields.

DINEOF is freely available for download at http://ocgmod2.marine.usf.edu, with compilation instructions for several Linux and UNIX platforms. Compiled binaries for Linux and Windows are also available. The user can interact with other DINEOF users through a mailing list, where technical problems are presented and scientific discussion encouraged.

We will present the latest applications developed for DINEOF, such as the multivariate reconstruction and the calculation of error maps, with several examples at different locations and spatial scales. An overview of the technique and future developments will be also discussed.

References:

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