Advanced Data Interpolating Variational Analysis: Application to climatological data.

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1. Objectives

Data is a method applied to grid sparse and noisy data. It has been successfully used to create regional climatologies (North Sea, Black Sea, Baltic Sea, Mediterranean Sea...). Here we will:

\begin{itemize}
  \item Present the new features of a method applied to grid sparse and noisy data.
  \item Demonstrate its capabilities on a realistic application.
\end{itemize}

2. Data and method

- **Data set**: combination of SeaDataNet (http://www.seadatanet.org) + World Ocean Database 2009 (WOD09, Boyce et al., 2009).
- **Period**: 1950-2010
- **Month**: September
- **Depth**: 30 m
- **Total**: 4699 data points, 352 randomly chosen for validation (Fig. 1)

3. Parameter estimation

Coefficients \( \mu_1, \alpha_1 \) and \( \alpha_2 \) related to data through:

\begin{itemize}
  \item the correlation length \( L \) estimated by fitting of the data covariance to an analytical function (for \( L = 150 \) km).
  \item the signal-to-noise ratio \( \lambda \) estimated ordinary or generalized cross-validation (Fig. 2) \( \Rightarrow \lambda = 4.02 \).
\end{itemize}

4. Advection constraint

Advection is taken into account in the functional by adding a term in (2):

\[ J_a = J(\psi) \frac{\theta}{\theta} \int_D \left[ \nabla \cdot (\psi v^a - \frac{1}{2} \nabla \psi v^a) \right]^2 d\Omega, \]  

where \( \psi \) is the velocity scale and \( \theta \) measures the strength of the advection.

5. Error fields

Recent developments allow the estimation of the real covariance function (Troupin et al., 2011). Errors are compared in Fig. 5. Four man’s method underestimates the error. The other methods provide similar results, with the largest errors along the coasts of Libya.

6. Outliers detection

Random data points are displaced or have their salinity artificially changed. The outlier detection criterion implemented in Data allows us to catch them (Fig. 6).

7. Comparison with OI

The example shows the influence of the boundaries on the analyzed field. The difference of two fields is weak in the open ocean, but larger close to the coast.

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Main references

