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Can we trust Mediterranean hydrographic data products (MEDAR, EN3, Ishii) for climate studies?

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The description and understanding of the long term variability of temperature and salinity fields bases on the availability of historical hydrographic observations. In the Mediterranean Sea the coverage of observations is highly inhomogeneous, presenting large data voids in both space and time. In order to partially overcome this problem, gridded products have been generated through the objective analysis of the available observations. Products generated from the MEDAR, Ishii or EN3 data bases for instance are very useful and hence widely used to analyze the climate variability at different scales. However, the fact that gridded products have a homogeneous spatio-temporal distribution does not mean that the problems derived from the paucity and inhomogeneity of observations have been overcome. In this work we quantify the uncertainties associated with the diagnostics inferred from current Mediterranean hydrographic products. In particular, we characterize the errors in the climate variability of the temperature and salinity fields at different depths for the period 1960-2008.

The methodology bases on the extraction of temperature and salinity pseudo-observations from the output of an ocean hindcast. Those pseudo-observations have the same spatio-temporal distribution than the available actual observations and are then used to generate gridded products using Optimal Statistical Interpolation. The comparison between the generated products and the original model data is assumed to give a quantitative, reliable estimate of the uncertainties associated with the products. The pseudo-observations have been extracted from the output of the NEMOMED-8 model (spatial resolution of 1/8º) forced with the output fields of the atmospheric model ARPERA (50 km resolution).

Results show that gridded products present damped spatial and temporal variability with respect to actual fields. The damping is due to the smoothing of the interpolation and to the use of a climatological background field where/when no observations are available. The number of available observations seems to be not enough to properly capture the actual variability, even at long spatio-temporal scales. RMS errors of monthly basin averaged quantities are 0.7ºC for 10 m temperature, 0.5ºC for 100 m temperature, 0.3 psu for 10 m salinity and 0.2 psu for 100m salinity. More importantly, the monthly variance accounted for by the gridded products is 45% of the actual variance in the best case (10m temperature), reducing to 12% at 500m and 5% at 1000m. For salinity, the variance accounted for by the gridded products is only significant at 10 m depth (15% of actual variance). Results also show that errors are larger in summer even if more observations are available during that season. The reason is that the increase in the field variability during the summer months would require a larger-than-actual increase of observations to properly characterize the fields. Finally, the uncertainty on the derived long term trends is also assessed. Our results suggest that actual trends are significantly underestimated when they are computed from gridded products.