Skills of different hydrographic networks to capture changes in the Mediterranean Sea at climate scales

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Llasses,J.,Jordà, G.,Gomis D.,(2015). Skills of different hydrographic networks to capture changes in the Mediterranean Sea at climate scales. Climate Research Journal. Doi: 10.3354/cr01270

1. INTRODUCTION AND OBJECTIVE

Climate monitoring is nowadays a crucial issue, particularly in "hot spot" regions such as the Mediterranean Basin (see e.g. Giorgi 2006), where climate changes are expected to be large (see **Fig1**). In such a context it is worth putting in question **the capability of 5 observational networks** (see panel 2) **to properly monitor Mediterranean climate variability** and, in particular, climate change signals.

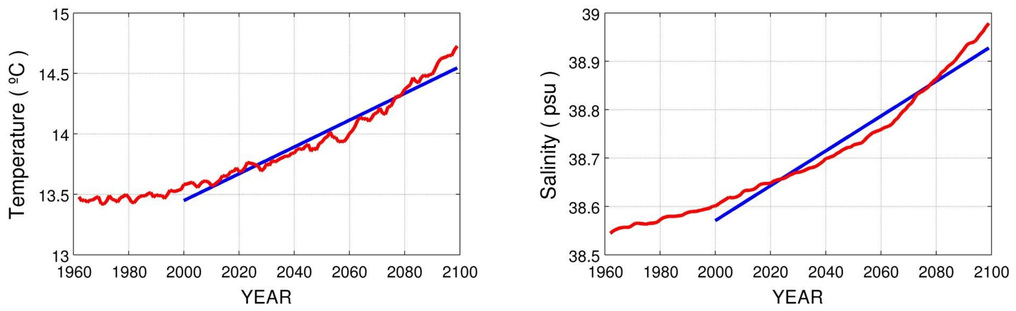


Fig1 : Evolution of the annual basin averages of 3D Temperature (left) and Salinity (right) obtained from NEMOMED8 numerical simulation. Blue line represents the linear trend computed for the 2000-2100 period.

2. OBSERVATIONAL NETWORKS

1) **Oceanographic cruises** The dedicated surveys and ships of opportunity

2) **Argo buoys.** The Argo buoys drifters

3) **Moorings.** A virtual net of 16 spatially regular distributed mooring network

4) **Realistic network**. The actual observational network (consisting in CTD casts, Argo buoys and the actual net of coastal moorings)

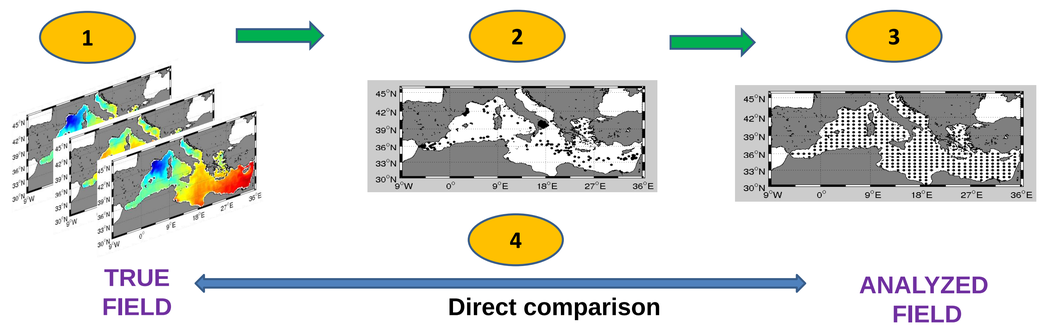
5) **Target network:** An optimistic but reachable future network where the actual observational network is actualized

6) **Reference** A very high spatial and temporal density net of moorings. It represents an ideal but not realistic system that will serve as a reference to compare the results of the networks described above.

Note: *A typical example of the spatial coverage of the six networks and the gridded fields generated with each of them is presented in panel 3 (Fig.2)*

3. METHODOLOGY

From a numerical simulation (NEMOMED8) considered as the (virtual) "truth" (1) we extract a set of temperature and salinity pseudo-observations (2) with the same spatio-temporal distribution as the different networks (panel 2). Finally, an Optimal Statistical Interpolation method is implemented to the extracted pseudo-observations in order to obtain gridded products (3). The gridded products are then compared with the true field in order to evaluate the capabilities of the networks in capturing the true climate signals



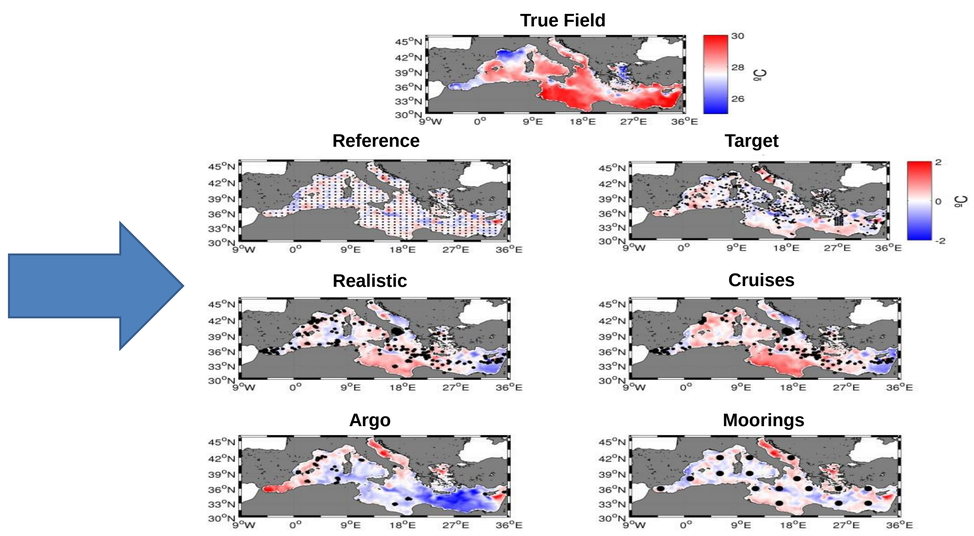


Fig2: *An example of the spatial coverage of the 6 networks and the corresponding gridded fields generated with each of them for a single month presented as differences with respect to the true field*

4. RESULTS

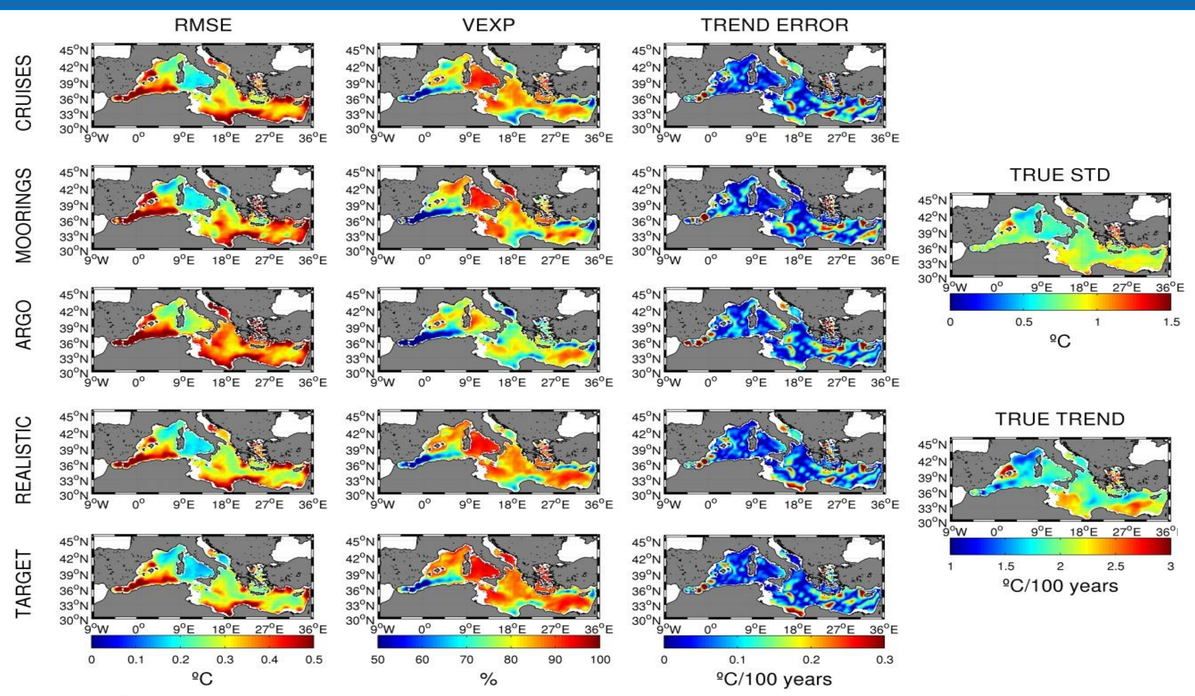


Fig.3: *RMSE (root mean square error), VEXP (explained variance) and trend error for the 100 m temperature. All maps correspond to the 2000-2100 period. Same kind of maps are obtained for salinity too (not shown)*

None of the observational networks are able to capture local features

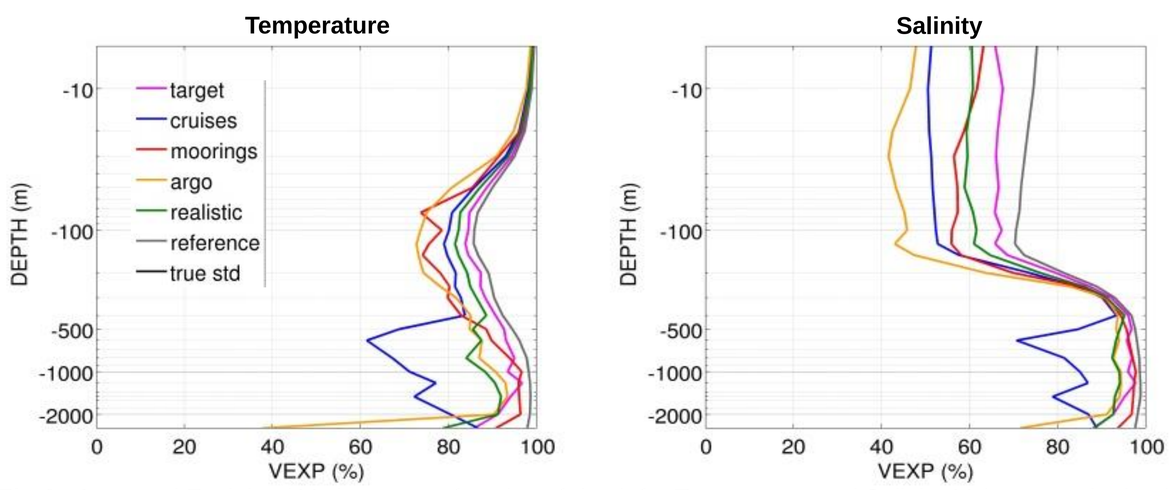


Fig.4: *Averaged Explained Variance as a function of depth for Temperature and Salinity. Values are obtained for the 2000-2100 period.*

The performance of each network depend on the variable and the depth. For temperature, the skills decrease between 50-500m; for salinity the skills are low between 0-400m

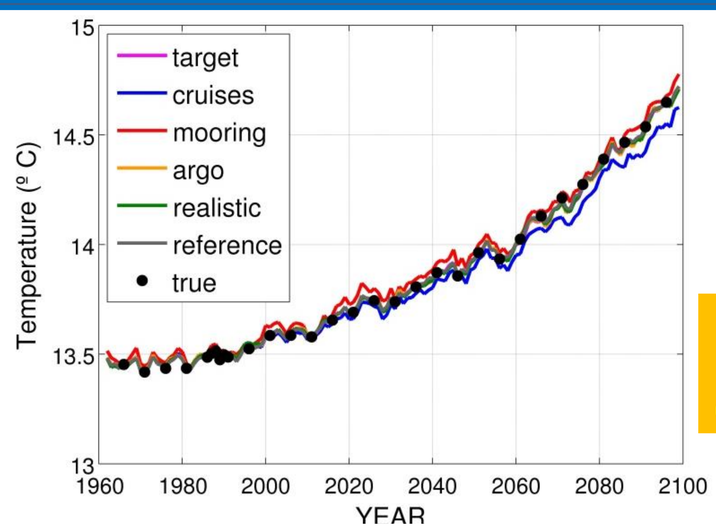


Fig.5: *Time-series of the 3D basin averages obtained from the 6 networks for the period 1962-2100. Black dots represent the true field. The picture regarding the basin averaged salinity (not shown) is very similar*

Basin averaged quantities are well captured by all networks

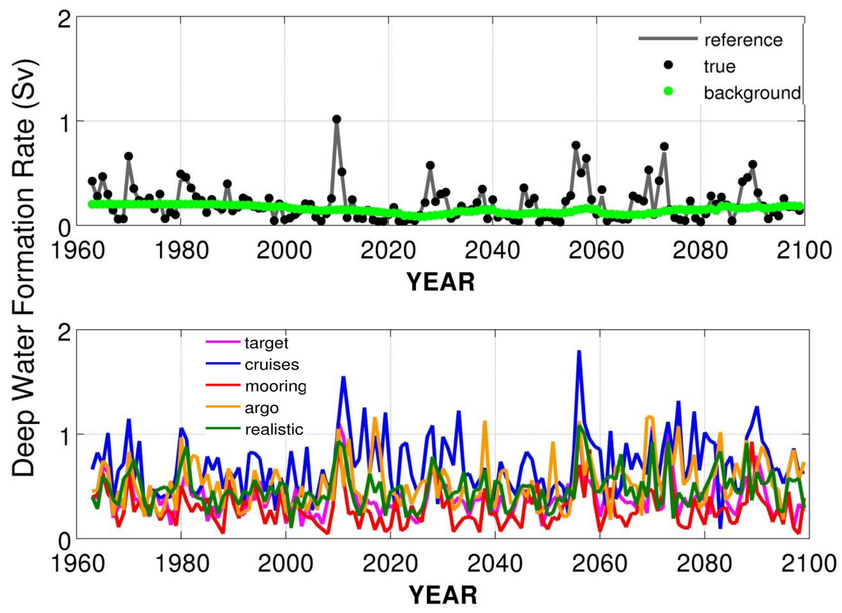


Fig.6: *Deep Water Formation rate in the Western Mediterranean*

The Dense Water Formation rates are not well captured

The best results are obtained with the target network, but the differences with respect to the present observational network are not very large

Argo and cruises show the worst results while moorings only improves the realistic sampling performance in capturing the DWF rate

This work can serve as guidance in order to design a better monitoring system.