Validation of ECMWF analysis winds in the Mediterranean basin with ASCAT 12.5 km winds

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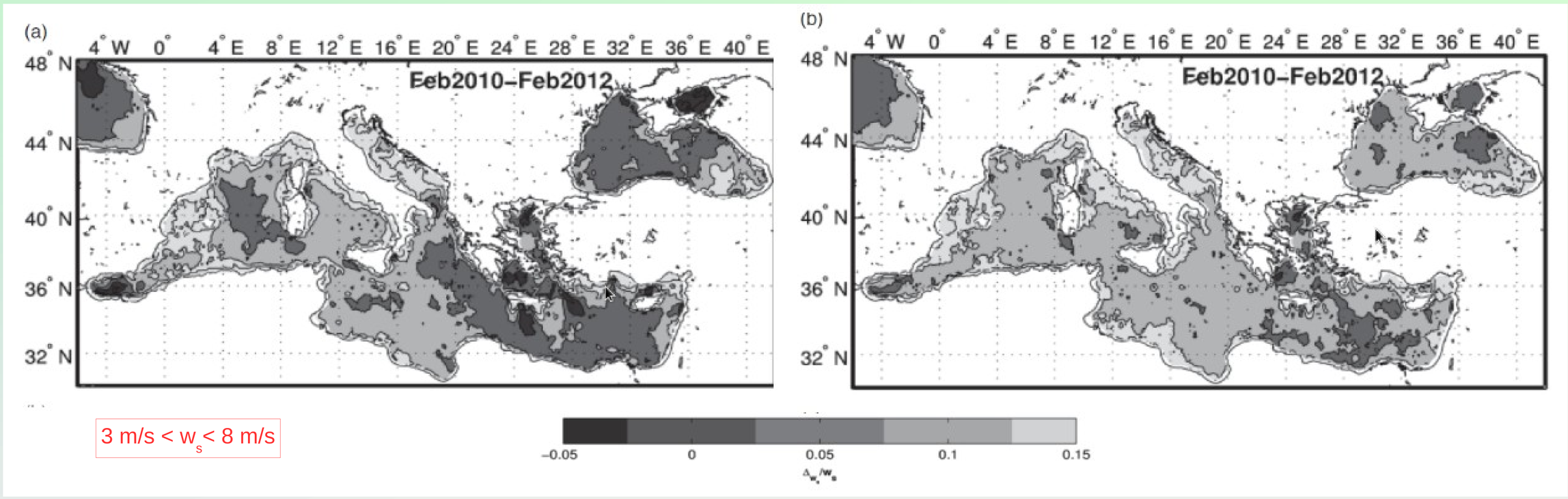
Summary

To what extent the winds fields from an advanced numerical weather prediction system and from a satellite scatterometer describe the same spatial and temporal features of the sea surface wind in the Mediterranean Sea? Two statistical parameters have been found relevant and simple at the same time: the bias (Δw_s) and the centered root meas square deviation ($RMSD^c_{ws}$) of the wind fields (scatterometer and model). Both are normalized to the scatterometer wind speed (w_{sc}), in order to supply nondimensional numbers: $\Delta w_s/w_{sc}$ and $RMSD^c_{ws}/w_{sc}$. Then a time average has been performed on each point of a lat-lon grid. The ASCAT–ECMWF $\Delta w_s/w_{sc}$ and $RMSD^c_{ws}/w_{sc}$ of wind speed have been found to be 7% and 23%. An interesting result is the identification of dependence of both $\Delta w_s/w_{sc}$ and $RMSD^c_{ws}/w_{sc}$ on the distance from the coast, indicating the coastal areas as the main source of discrepancy between the two data sets. From 50 to 200 km away from coast, $RMSD^c_{ws}/w_{sc}$ decreases from 40 to 25% and $\Delta w_s/w_{sc}$ from 8 to 4%. These results gain more importance considering that the Mediterranean Sea is essentially a coastal sea (50% of its surface lies within 50 km from the coast). The decrease with distance from the coast for the various statistics, may be an indication of the 'blurring' of the characteristics of the wind over land (mainly affected by the parametrization of the physical processes and orography) into the sea. In fact, this could be the result of the well-known difficulty of the models to reproduce phenomena at scales shorter than a few times the grid length. However, attention must be paid also on the quality of the scatterometer data.

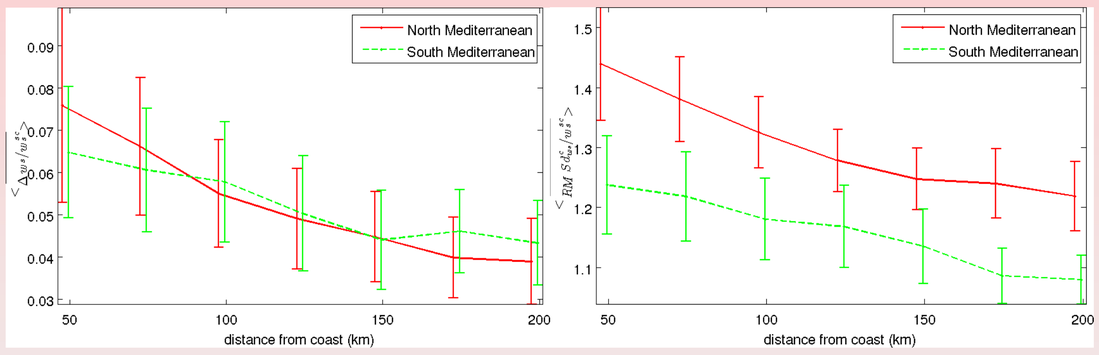
Spatial statistics of normalized bias $<\Delta w_s/w_{sc}>$

These figures show the mean normalized bias $\Delta w_s/w_s$ over the period February2010-February 2012. Δw_s is the scatterometer-ECMWF wind speed. ECMWF analysis winds result underestimated with respect to ASCAT almost everywhere and particularly in coastal areas (~ 15%).



(from Zecchetto and Accadia, OJRMS 2014)

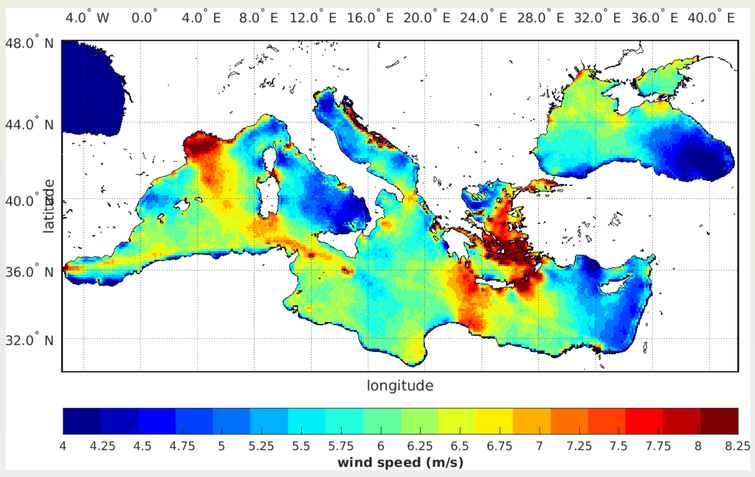
Statistics with distance from coast



This figure shows $\Delta w_s/w_s$ (left panel) and $RMSD^c_{ws}$ (right panel) as a function of the minimum distance from coast. They decrease with the distance from the coast both in the northern and southern Mediterranean Sea and the rate of decrease with the distance is very similar. It also shows that only $RMSD^c_{ws}$ is systematically larger in the northern shores of the Mediterranean Sea, which are generally downwind to the prevailing winds. This suggests that the modeled winds in the coastal regions surrounded by areas with significant orography provide a reduced representativeness of the local wind field, possibly due both to the intrinsic numerical smoothing of the model and to the physical parametrization of the effects of orography (e.g. sub grid orographic drag), with the net effect of under representing the spatial variability of the wind in these complex regions, resulting in an increase of $RMSD^c_{ws}$.

Scatterometer data quality

Recently, we discovered that scatterometer data are corrupted by the presence of ships (Zecchetto and DeBiasio, summitted). This figure shows an example derived from QuikScat scatterometer, which illustrates the problem (ASCAT data are also contaminated, but with less evidence), reporting the 2007 mean field. Signatures of high winds hardly ascribable to geophysical phenomena, located along off-shore straight lines (from Gibraltar -5.5º E, 36º N to Port Said 31.25º E, 32.25º N, for instance) and close to coasts are visible.
This can alter the results obtained from scatterometer data, as those reported here, and must be corrected for any use of scatterometer data.



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