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

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Summary

To what extent do 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) and the centered root mean square deviation (RMSD_c) of the wind fields (scatterometer and model). Both are normalized to the scatterometer wind speed (w_s), in order to supply nondimensional numbers: Δw/w_s and RMSD_c/w_s. Then a time average has been performed on each point of a lat-lon grid. The ASCAT–ECMWF Δw/w_s and RMSD_c/w_s of wind speed have been found to be 7% and 23%. An interesting result is the identification of dependence of both Δw/w_s and RMSD_c/w_s 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/w_s decreases from 40 to 25% and Δw/w_s 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 <Δw/w_s>

These figures show the mean normalized bias Δw/w_s over the period February 2010-February 2012. Δw is the scatterometer-ECMWF wind speed. ECMWF analysis winds result underestimated with respect to ASCAT almost everywhere and particularly in coastal areas (~15%).

Statistics with distance from coast

This figure shows Δw/w_s (left panel) and RMSD_c (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 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 representation 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.

Scatterometer data quality

Recently, we discovered that scatterometer data are corrupted by the presence of ships (Zecchetto and De Biasio, submitted). 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.

References

Zecchetto S., F. De Biasio, Ships contamination of satellite scatterometer winds, TGRS, submitted