HIGH VS. LOW RESOLUTION ATMOSPHERIC FORCING OVER THE ADRIATIC

Z. Pasarić *, D. Belusić , Z. Bencetić Klaić , M. Orlic , M. Pasarić , M. Pavić
Andrija Mohorovicić Geophysical Institute, Faculty of Science, University of Zagreb, Horvatovac bb, 10000 Zagreb, Croatia - pasaric@irb.hr

Abstract

High resolution meteorological fields over the Adriatic derived from mesoscale ALADIN/HR model for the Nov/2002 - Sep/2003 period are compared with corresponding low resolution fields obtained from global ECMWF model. The analysis is performed on mean values calculated over strong bora and strong sirocco episodes. It is shown that not only bora but also the sirocco-type weather is largely influenced by local orography. The results suggest that use of mesoscale meteorological forcing can significantly improve oceanographic forecasting in the Adriatic.

Keywords : Adriatic Sea, Atmospheric Input, Circulation.

In recent years significant effort is undertaken in the field of operational oceanography of the Mediterranean Sea (e.g. http://www.moon-oceanforecasting.eu). Among other goals, a numerical forecasting system at basin scale, but also on regional and shelf scales, is developed. The Adriatic Sea in particular is covered by a regional hydrodinamical model and several shelf models [1], where the necessary boundary conditions are prescribed by simple one-way nesting between respective models [2]. Available at the time, the atmospheric forcing was taken from global ECMWF model having 0.5 degrees longitude and latitude resolution which is far from enough to resolve fine structure of the Adriatic weather, known to be strongly influenced by local orography, e.g. [3]. To get a better insight into deficiencies thus introduced, in the present work the ECMWF fields are compared with the corresponding output of the mesoscale meteorological model ALADIN/HR.

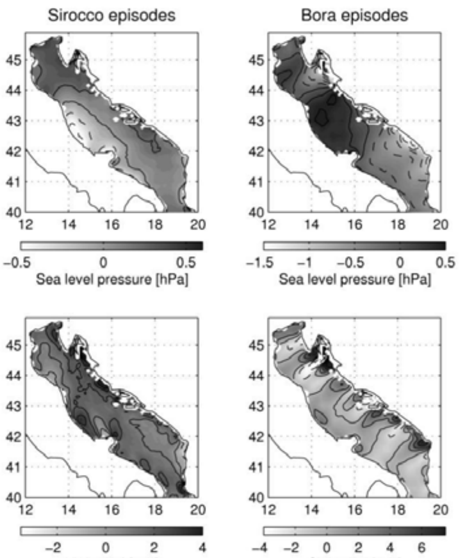

Fig. 1. Mean differences between the ALADIN and ECMWF modelled air pressure (top) and the wind speed component along the main airflow (bottom) for sirocco (left) and bora (right) episodes during the November 2002 - September 2003 period. Full lines show positive, dotted lines negative differences.

We used ALADIN output fields every 3 hours, having spatial resolution of 8 km, spanning over the period from 1 November 2002 till 30 September 2003. Respective ECMWF fields that were available every 6 hours were trilinearly interpolated onto the ALADIN space-time grid. The analysis was conducted around two most prominent types of Adriatic weather, namely those characterized by strong bora and strong sirocco winds. To that end three characteristic grid points were chosen in the northern part, and three in the southern part of the Adriatic. Bora (sirocco) episodes were extracted as all instances (80 ones for bora, 63 for sirocco) where all six grid points have wind from the first (fourth) quadrant stronger than 8 m/s. Mean differences between ALADIN and ECMWF modelled fields were calculated over these bora and sirocco episodes, separately (Fig. 1).

Due to the finer spatial resolution and consequently more realistic land-sea mask and topography, in the discussion below, ALADIN modelled fields are considered as referent. The air pressure differences between the models (Fig. 1, top) show large contiguous areas of the same sign with amplitudes up to 2 hPa. For the sirocco situations, ECMWF generally underestimates the air pressure over the northern Adriatic and along the middle and southern east Adriatic coast. On the other hand, almost all along the Italian coast south of Ancona, the ECMWF predicted pressure is higher than the ALADIN predicted one. The region where this overprediction is particularly wide as measured in the offshore direction extends from Ancona to Gargano peninsula. For bora conditions, the air pressure predicted by ECMWF is lower over the major part of northern and middle Adriatic, while south-eastward of Istria Peninsula and over the southern Adriatic it is higher.

A comparison between the ALADIN and ECMWF predicted sirocco and bora winds shows discrepancies generally oriented along the main airflow. Hence, Fig. 1 (bottom) presents mean differences of north-westward component of sirocco and south-westward component of bora winds. The ECMWF sirocco speeds are generally lower than the ALADIN ones (in some regions even more than 4 m s^{-1}). Further, an interesting pattern with alternation of jet-wake-jet structure is found north of Gargano. It seems to be a consequence of the blocking and splitting of sirocco flow upstream of Gargano, which is almost an ideal 3D obstacle. Accordingly, downstream of mountain a typical pattern of the airflow around the 3D obstacle emerges with the wake in the central part of the lee and jets emanating from the obstacle edges. Additionally, the jet emanating from the western flank of Gargano is amplified due to the channelling along the valley between the Gargano and Apennines. A third amplifying effect on the jet originates from the north-eastward downslope flow on the east side of the Apennines. The three amplifying mechanisms seem to result in airflow convergence northwest of Gargano above the Adriatic, which is associated with the low pressure discrepancy (Fig. 1 top). The jet penetrates far northward over the Adriatic. Over the eastern Adriatic, the regions with underpredicted sirocco winds are also found downstream of topographical obstacles, and they have similar values as over the greater Gargano area. The discrepancies between the ECMWF and ALADIN predicted bora winds also show the expected alternation of jet-wake patterns [3], thus confirming that ECMWF is not able to simulate the complex bora structure.

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References

1 - Castellari, S. (ed.), 2006. ADRICOSM, Final Scientific Report, INGV, Bologna, pp. 267-287.
2 - Zavatarelli M. and Pinardi N., 2003. The Adriatic Sea Modeling System: A nested approach. *Ann. Geophys.*, 21: 345-364.
3 - Grubisić, V., 2004. Bora-driven potential vorticity banners over the Adriatic. *Q. J. Roy. Meteor. Soc.,* 130: 2571-2603.