P1.9 INFLUENCES OF OROGRAPHY ON THE ADRIATIC SIROCCO WIND

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1. INTRODUCTION

Orographic effects on the airflow over the Adriatic Sea have been studied primarily in terms of the bora wind (e.g. Belušić and Klaić, 2006). This is quite natural, as the bora is a downslope windstorm which swoops down directly at the Adriatic and hence exerts strong forcing on the sea (e.g. Pullen et al., 2007). Significantly less attention has been given to the Adriatic sirocco wind (locally called *jugo*). The Adriatic sirocco is usually treated as a branch of the larger scale Mediterranean sirocco wind. Several studies have, however, shown that the Adriatic sirocco is sometimes influenced by specific local effects (e.g. Brzović, 1999). The sirocco blows from the southeast along the Adriatic. As the main mountains ranges (the Dinaric Alps to the east and the Apennines to the west) are aligned along the Adriatic as well (Fig. 1), the influence of the terrain on the airflow has not been regarded as significant. This study shows that smaller scale terrain features, seen only in models with higher horizontal resolutions, can influence the sirocco airflow in a significant way.

2. DATA AND METHODS

If the fields from an atmospheric model with lower resolution are considered as a sort of smoothed or filtered values (e.g. Fig. 1), then the differences between the higher and lower resolution results emphasize the smaller-scale orography effects. This is particularly so when the statistics over a larger time period is examined. In this study two models at different resolutions are used: the ECMWF global model with the coarser grid (0.5° horizontal resolution) and the ALADIN model. ALADIN is the operational model of the Croatian Hydrological and Meteorological Service run at the horizontal resolution of 8 km. The output fields from ECMWF are given every 6 hours, and from ALADIN every 3 hours. For the purpose of calculating the differences between the models, the ECMWF fields are interpolated onto the ALADIN space-time grid.

The inspected period is November 2002 – September 2003, thus almost a year-long data set. The total of 63 strong sirocco episodes were extracted during the period, where a sirocco episode is defined as the wind from the fourth (i.e. southeast) quadrant being stronger than 8 m s^{-1} at predefined 6 grid points over the sea.

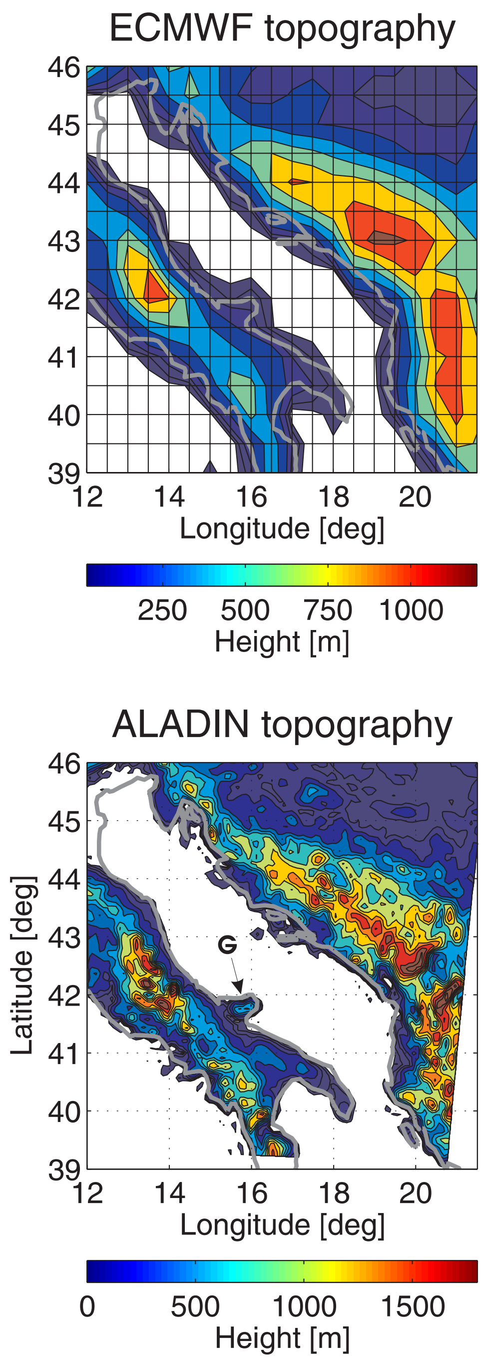

Figure 1. ECMWF and ALADIN orography. The gray line denotes the actual coastline. The 0.5° grid is depicted for ECMWF. G denotes Gargano.

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3. RESULTS

Figure 2 depicts the mean wind from ALADIN over the extracted sirocco episodes. These fields are taken as referent, as they are at the finer horizontal resolution.

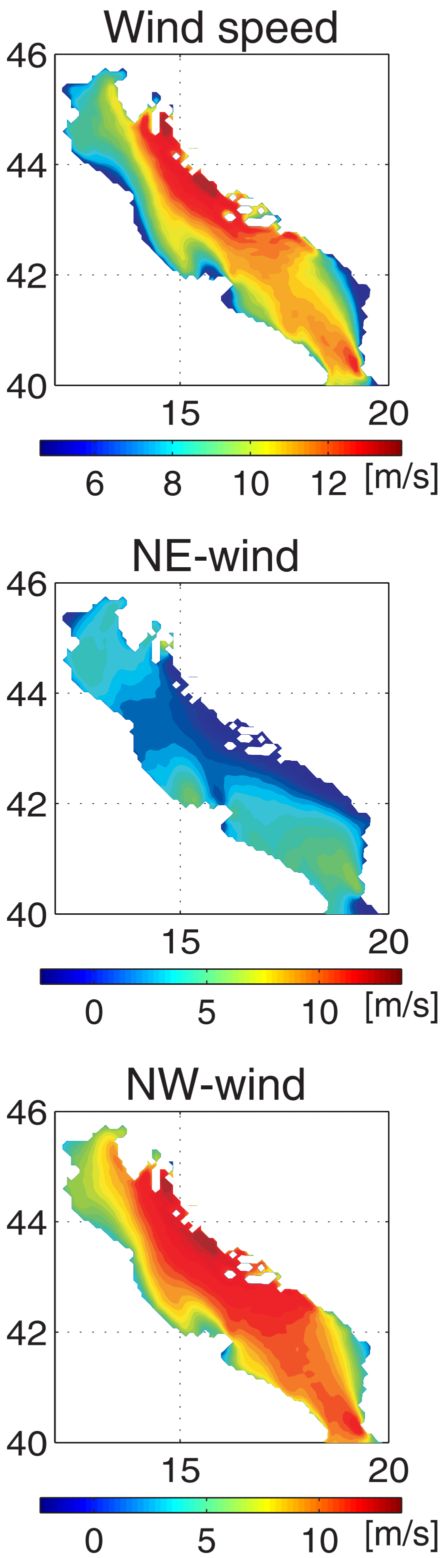

Figure 2. Mean ALADIN fields over the 63 episodes. NE and NW here denote the wind component toward NE and NW.

However, as Fig. 3 shows, the smaller-scale airflow features emerge primarily from the fields of mean differences between ECMWF and ALADIN (Pasarić et al., 2007).

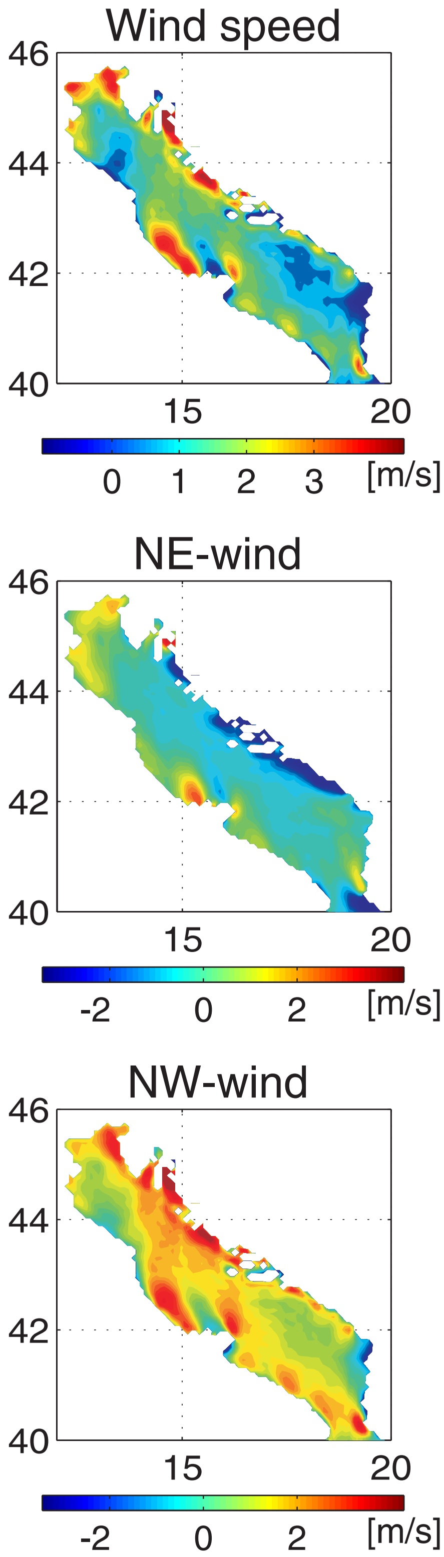

Figure 3. Mean differences (ALADIN-ECMWF) over the 63 episodes. NE and NW here denote the wind component toward NE and NW.

It is seen in Figure 3 that the differences are generally aligned with the mean flow direction. The most prominent features emerge north of Gargano. The pattern is similar to the flow structure behind a 3D obstacle, with the wake along the centerline and two jets at the sides. As these fields are averaged over 63 episodes, the pattern has to be quite persistent and hence may be treated as common for the sirocco in general.

The simplest way to study the generating mechanisms of these features is to turn to individual episodes. Figure 4 shows a strong sirocco event over the Gargano at 00 UTC 28 December 2002. Indeed, the pattern is mainly due to the Gargano mountain, which has almost an ideal 3D shape. The jet to the west is additionally amplified by two mechanisms: the channeling between the western flank of Gargano and the Apennines, and the strong downslope flow down the eastern edge of the Apennines. The three flows converge northwest of Gargano creating the strong jet. The wake is located behind the mountain peak and the eastern jet is superimposed on the undisturbed sirocco flow.

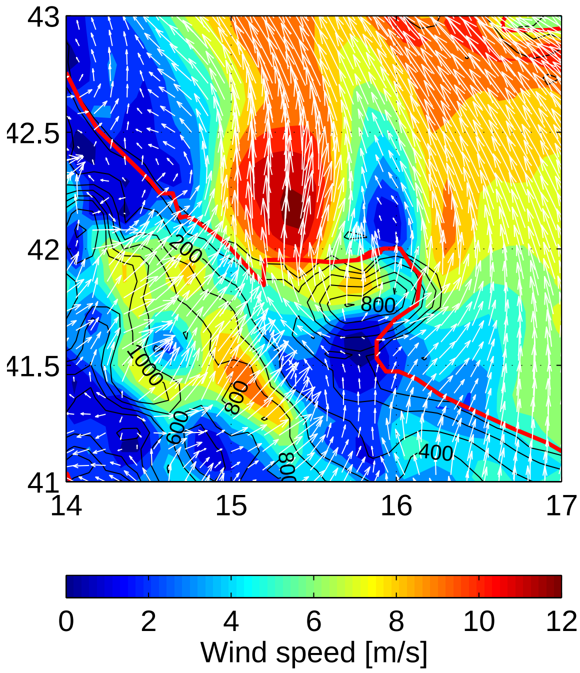

Figure 4. Surface winds (vectors and color) from ALADIN over the Gargano area at 00 UTC 28 December 2002.

3. CONCLUSIONS

The peculiarity of Gargano lays in the fact that it extends off the west Adriatic coast into the Adriatic. Due to its relatively high orography, it may influence the airflow that is directed along the Adriatic; sirocco in this case. The results show that it represents a 3D obstacle for the sirocco flow which induces the typical jet-wake-jet pattern in the lee. The consequences of this airflow pattern on the air-sea interaction could be significant. Namely, the Western Adriatic Current (WAC) reversal that may appear during the sirocco wind (e.g. Poulain et al., 2004) has been shown to depend on the sensitive balance between the bottom-slope and wind-curl effects (Orlić et al., 1994). The enhancement of the western Gargano jet reduces the typical sirocco wind curl (stronger winds at the east coast) and hence possibly enhances the WAC reversal. To demonstrate the last point, it would be required that the finer scale and oceanographic numerical simulations be performed.

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