NUMERICAL SIMULATIONS OF SEVERE SIROCCO EVENTS AT SARAJEVO INTERNATIONAL AIRPORT

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Abstract: During strong or severe sirocco episodes, pilots at Sarajevo International Airport often report significant turbulence that can cause difficulties during the landing procedures. Measurements at two airport locations show that these episodes are accompanied by strong wind gusts. This study examines several such episodes that occurred between 22 November and 6 December 2005. Numerical simulations of selected sirocco events were performed by the mesoscale model MM5. The establishment of the topographically induced potential vorticity (PV) banners was particularly investigated.

***Keywords**: mesoscale, PV banners, topography, turbulence, wind gusts*

1. INTRODUCTION

Sirocco (locally *Jugo*) is a warm and humid southeasterly or southerly wind common during the winter season. In most cases the formation of sirocco is related to the west-Mediterranean cyclone or the Genoa cyclone. It can further strengthen and develop into a strong or severe gusty windstorm. Additionally, in just a few minutes, wind direction can change and sirocco may turn into a very strong bora.

The sirocco is typical for southern Adriatic, where it lasts longer than in the northern parts. The effects of sirocco are present in continental regions, such as Sarajevo, as well. Pilots approaching to and departing from the Sarajevo International Airport (Figure 1) report turbulence during strong or severe sirocco episodes. Moreover, the same episodes are also accompanied by strong wind gusts measured at two airport locations.

This study examines several such episodes that occurred between 22 November and 6 December 2005. The episodes were characterized by the synoptic pattern typical for the severe sirocco (Vukičević et al., 2005), i.e. a deep low south of the Alps.

It is known that the topography may have significant influence on the sirocco airflow (Pasarić et al., 2007), and, that sirocco can get stronger due to the channelling effects of the surrounding mountains (Orlić et al., 1994). Further, downstream of the topographical obstacles, potential vorticity (PV) banners can form (Hoinka et al., 2003; Schär et al., 2003; Klaić et al., 2003; Grubišić, 2004; Belušić and Klaić, 2006). Therefore, the focus of this study is the establishment of the topographically induced PV banners and the role of the nearby mountain Igman in their formation. Additionally, the applicability of the wind gust estimation method, which was shown to be appropriate for the bora airflow (Belušić and Klaić, 2004), is inspected for sirocco.

2. WIND DATA

Automatic weather stations (AWS1 and AWS2) for the wind speed and direction measurements are situated approximately 1 km apart along the runway (direction 120-300). Wind sensors at AWS1 (43.83ºN, 18.32ºE, 502.18 m ASL) are mounted on a 10 m high mast, while sensors at AWS2 (43.83ºN, 18.34ºE, 511 m ASL) are located at the Airport Control Tower, 25 m above ground. Terrain is slightly inclined and the vertical distance between the two sites is approximately 25 m. An example of the original wind data, shown in Figure 2, corresponds to the time series of 1-min mean wind speed for the strongest sirocco episode which started at 04 UTC and ended at 12 UTC 26 November.

For each sirocco episode vertical profiles derived from the atmospheric soundings at Zadar (44.10ºN, 15.35ºE, 80 m ASL) were examined. Belušić et al. (2004) studied gust behaviour in severe bora cases, showing that the appearance of the upper-tropospheric jet stream is related to the disappearance of the wave-

breaking region in the lee of the mountain. Since the jet stream was also found during sirocco episodes (Figure 3) we examined the relationship between the jet stream occurrence and strong/severe sirocco.

Figure 1: Topography of the greater Sarajevo International Airport area. Operational runway (direction 120-300) is shown with red line.

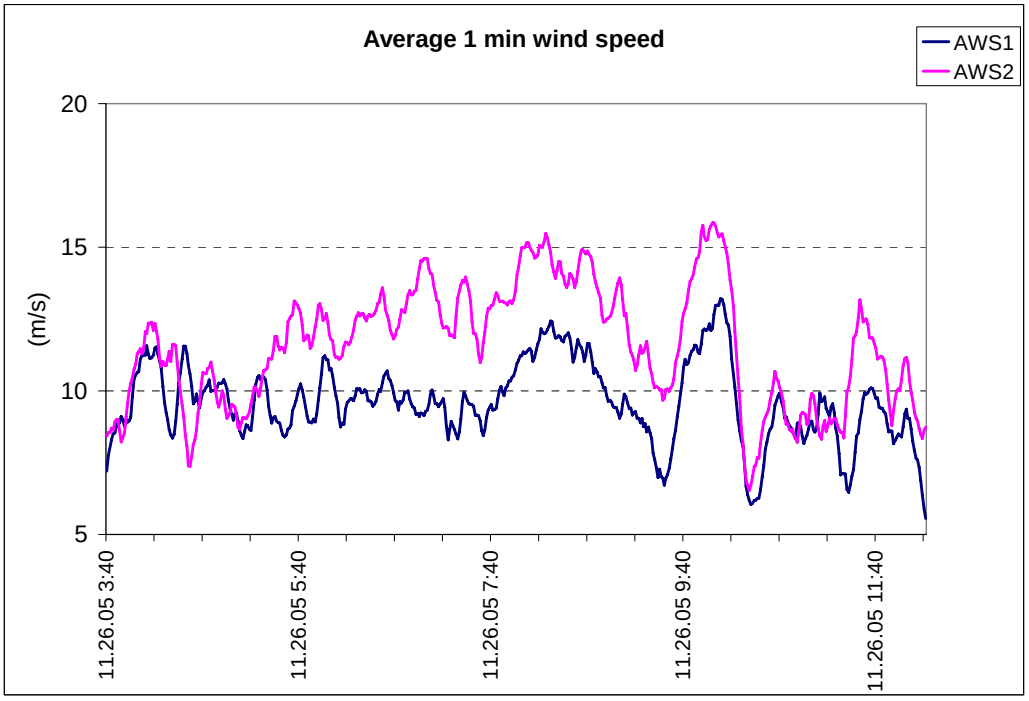

Figure 2: Time series of average 1 min wind speed measured at two automatic weather stations at Sarajevo International Airport, for the strongest sirocco episode, from 04 to 12 UTC 26 November 2005.

3. NUMERICAL SIMULATION AND RESULTS

Simulations were performed with nonhydrostatic Fifth-Generation Pennsylvania State University – National Center for Atmospheric Research (PSU-NCAR) Mesoscale Model (MM5) version 3.6.3 at the highest horizontal resolution of 1 km. MM5 is a three-dimensional, nested-grid, primitive-equation meteorological model that uses a terrain-following sigma (nondimensionalized pressure) vertical coordinate (Grell et al., 1995). Results were verified with Zadar radiosonde data and wind data obtained by the automatic meteorological stations AWS1 and AWS2.

Preliminary results of the research as well as validation of numerical simulation will be presented and discussed in the course of the conference.

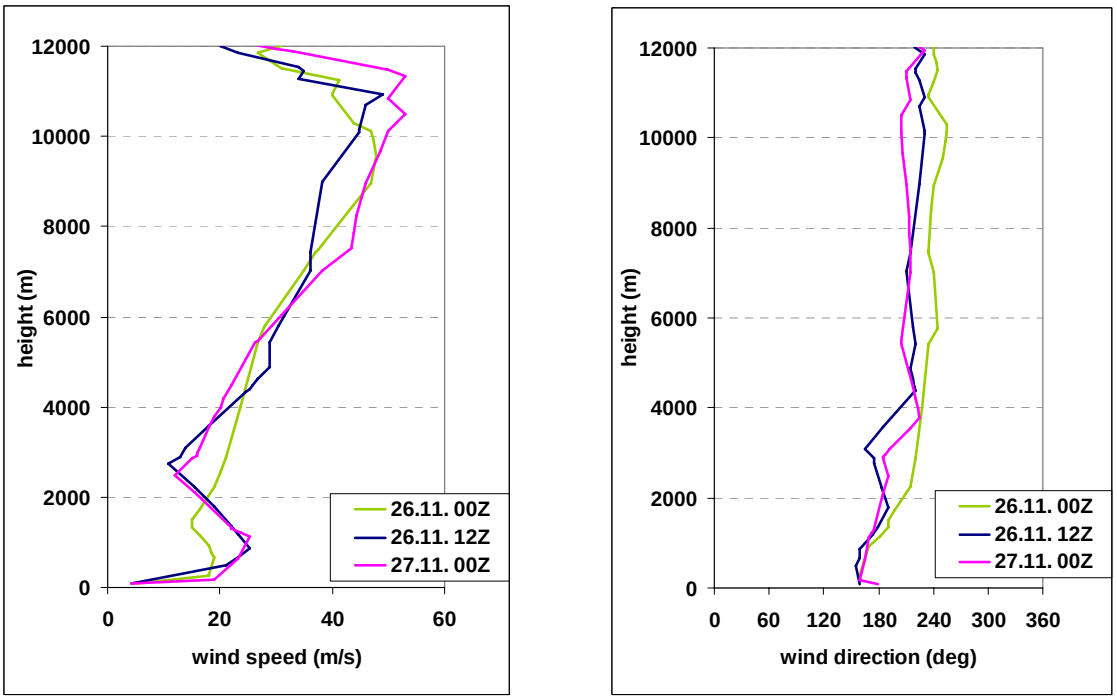

Figure 3: Upstream vertical profiles of wind speed and direction at Zadar for the strongest sirocco episode.

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