GEOFIZIKA VOL. 20 2003

Preliminary communication
UDC 551.553.11

Main characteristics of sea/land breezes along the eastern coast of the Northern Adriatic

Maja Telišman Prtenjak

Andrija Mohorovičić Geophysical Institute, Faculty of Science, University of Zagreb, Zagreb, Croatia

Received 6 August 2003, in final form 8 December 2003

An average daily wind regime along the Northern Adriatic eastern coast has been examined at 10 meteorological stations for summertime sea/land breeze circulation. The stations considered are Pula-Airport, Opatija, Rijeka, Senj, Malinska, Omišalj, Mali Lošinj, Rab, Zadar and Zadar-Airport. The aim was to examine the frequency, the times of onset and cessation, the average duration of sea/land breezes, and the impact of the Coriolis force on the wind vector rotation at chosen stations. The results are comparable with corresponding studies of mid-latitude locations. For two stations, an anticlockwise rotation has been discovered (Malinska and Senj), while the remaining stations showed a clockwise rotation, which prevails on the northern hemisphere coasts.

Keywords: sea breeze, land breeze, Northern Adriatic

1. Introduction

Despite the fact that sea/land breezes are quite frequent along the Northern Adriatic Croatian coast (between 40%–65% of days) (Figure 1), during the warm part of the year it is still not a very well examined phenomenon. The presentation of the wind regime by wind roses, streamlines or pressure fields for three climatological terms is not satisfactory if we want to learn about the diurnal behaviour in more detail. There are only a few studies, which describe the average 24-hourly cycle of sea/land breezes. Firstly, Orlić et al. (1988) demonstrated by a rotary spectra analysis the clockwise and anticlockwise rotary motions at three meteorological stations (Rijeka, Senj, Pula-Airport) in the Northern Adriatic. Then, Lukšić (1989) described the main characteristics of diurnal winds at the Senj station. These studies revealed an anticlockwise rotation (ACR) at the Senj station, which is unusual for the Northern hemisphere. At the Rijeka and Pula-Airport stations, Coriolis-induced veering (clockwise rotation (CR)) was found. Since the characteristics of the hourly mesoscale circulations are roughly known only for three stations, further work was necessary to obtain more details on sea/land breeze characteristics (Telišman Prtenjak, 1998/1999).

In this study, 10 meteorological stations have been examined and an average diurnal variation of the wind regime for the sea/land breeze event has been obtained for every station. The objective of this study is to detect the presence of both CR and ACR, the times of onset and cessation and the average duration of the sea breeze at a number of stations with sea breeze in Istria and the Kvarner Bay. The results of this study will be employed in the validation of a three-dimensional numerical model, which will be the objective of further study.

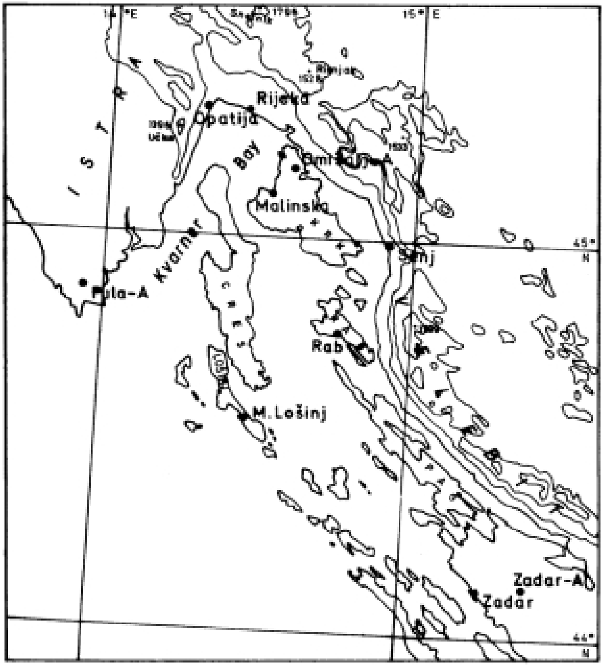

Figure 1. Map of the Istrian Peninsula and the Kvarner Bay, showing the measuring sites (Pula-A = Pula-Airport, Opatija, Rijeka, Senj, Malinska, Omišalj-A = Rijeka-Airport, M. Lošinj = Mali Lošinj, Rab, Zadar, Zadar-A = Zadar-Airport). The topography contours are given for every 500 m.

2. Methods

2.1. Data set

The Northern Adriatic climate belongs to the general Mediterranean type of climate (Penzar, 1976, 1977). The influence of the Azores maximum is pronounced in summer. Then, the persistent NW wind flow, known as the

Etesian, blows over the whole Mediterranean and brings a sunny and dry summer. In such circumstances, when the synoptic forcing is weak, local circulations dominate the area. Therefore, this paper uses observations from June to September over a four-year period (1999–2002), since the warm part of the year is favourable for sea/land breeze development (Figure 2).

Table 1. Station coordinates and the number of analyzed days with measurements. The last two columns show to the frequency of sea/land breeze occurrence and the duration of the sea breeze phenomenon in hours, respectively (see text for details).

Station name	φ (°)	λ (°)	Height (m)	Number of analyzed days	Frequency (%)	Duration of the sea breeze (h)
1. Pula-airport	44° 54'	13° 55'	63	306	44	8
2. Opatija	45° 20'	14° 19'	5	136	60	10
3. Rijeka	45° 20'	14° 27'	120	144	62	10
4. Senj	45° 00'	14° 54'	26	481	27	7
5. Malinska	45° 07'	14° 32'	1	299	44	10
6. Omišalj	45° 13'	14° 35'	85	301	50	10
7. Mali Lošinj	44° 32'	14° 28'	53	172	42	10
8. Rab	44° 45'	14° 46'	24	181	60	10
9. Zadar	44° 08'	15° 14'	5	120	53	11
10. Zadar-airport	44° 07'	15° 23'	96	243	60	9

For this study, 10 meteorological stations were selected (Fig. 1): Pula-Airport, Opatija, Rijeka, Senj, Malinska, Omišalj, Mali Lošinj, Rab, Zadar, Zadar-Airport and the number of days with measurements at each station is shown in Table 1.

2.2. Selection of days during which land/sea breeze prevails

There are several studies, which suggest possible criteria for the selection of sea breeze days from a larger data set (Lukšić, 1989; Borne et al., 1998; Furberg et al., 2002). Here, the selection was done according to surface measurements (10 m above ground) of wind speed and direction, surface air pressure, sea and surface air temperatures, and cloudiness. The main criterion was based on the change in wind direction during 24 hours. According to Furberg et al. (2002) the wind shift from offshore during the night to onshore during daytime hours can be formulated as:

(I) during the night, the majority of hourly winds should be offshore or calm and

(II) during daytime, the wind should blow onshore for at least two consecutive hours.

The estimation of the range of onshore and offshore flow is made subjectively, taking into consideration the direction of the local coastline.

At stations, such as Rijeka and Senj, with pronounced mountain hinterland, a land breeze from the northeast or north has been detected. It develops during the night and disappears in the morning. Occasionally, the night wind pulls air not only from the coastal mountain slopes, but from inland. Therefore, another filter was set:

(III) the average hourly wind velocity should be less then 5 m s^{-1} for at least 21 hours during the day.

To exclude the days when frontal systems pass over the area, both temperature and cloudiness criteria were used:

(IV) the diurnal air pressure amplitudes have to be smaller than 5 hPa, similar to Lukšić (1989);

(V) $T_{land} - T_{sea} > 3$ °C, where T_{land} is the daily maximal temperature over land and T_{sea} is the sea surface temperature (Borne et al., 1998);

(VI) and/or $N_{max} \le 5/10$, where N_{max} is the daily maximal cloudiness. The connection of the sea breeze front with cloudiness such as cumulus or stratocumulus clouds is well known (Yan and Anthes, 1988; Simpson, 1994, Baker et al., 2001). A high-level cloud type (*e.g.* cirrus) can not solely suppress the development of sea/land breeze in the planetary boundary layer.

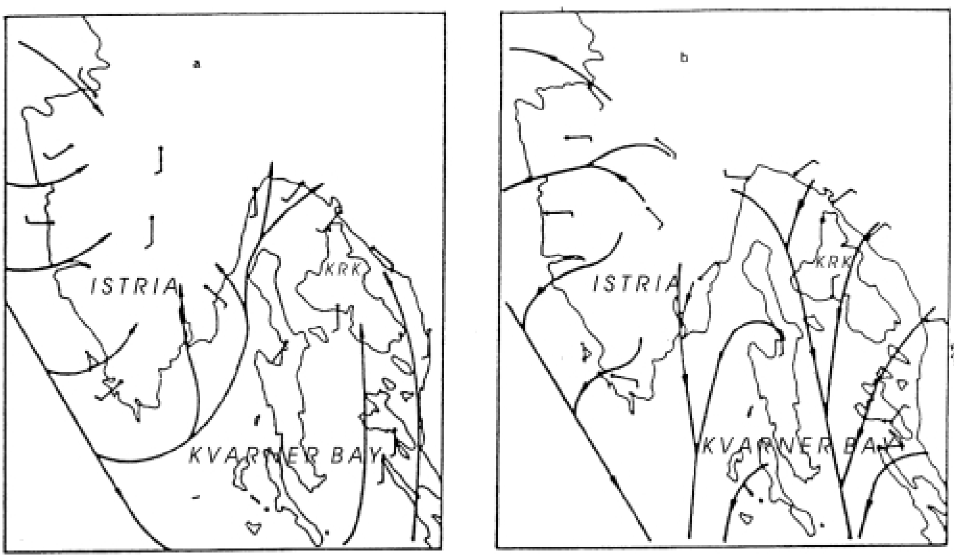

Figure 2. Streamlines of the wind field for the Northern Adriatic for the summer period (June, July, August) adopted from Penzar and Makjanić (1978) for (a) 14:00 LST, (b) 21:00 LST.

The objective of the application of the above mentioned criteria was to obtain an as large as possible physical set of sea/land breeze days during the summer period. A comparison between non-sea/land breeze days and sea/land breeze days gives the frequency of occurrence of this mesoscale phenomenon. Because of the diurnal nature of the sea/land breeze evolution, all times will be given as local standard time (LST).

3. Results

The main objective of this study is to get the average hodographs for the 10 chosen meteorological stations during the selected summer periods. Except for the Malinska and Senj stations, the hodographs showed a prevailing CR. The first group of hodographs (Figures 3–5) is characterized by the late incoming of sea breeze and they were obtained for the Pula-Airport, Omišalj and Mali Lošinj stations (Fig. 1). The Pula-Airport station is situated 10 km to the west of the sea, surrounded by a flat and open landscape. The Omišalj station is located at the airport, in the northern part of the island of Krk. This part of the island stretches along the meridian, which means that the sea breeze can develop from both the east and west side of the island. Mali Lošinj, a town on the island of Lošinj is situated in narrow zone, on the southeastern part of a large and well-protected bay.

According to the results in Figures 3–5, the direction of the wind vectors at nighttime is approximately from NE-NNE. The wind nighttime direction suggests the appearance of a land breeze with speeds around 1.5 m s^{-1} and very high steadiness (more then 75%). Late-morning values (from 9:00 to

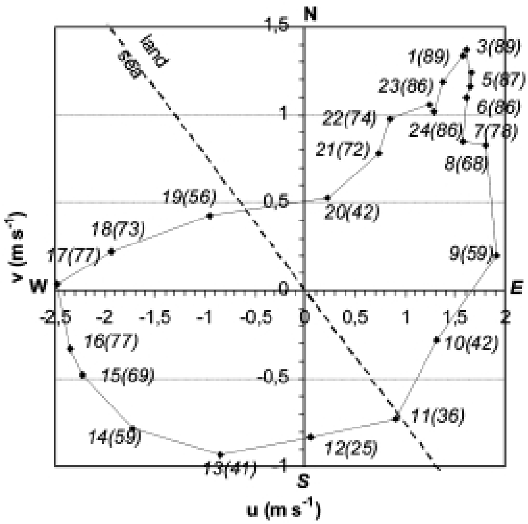

Figure 3. Hodograph of the average surface wind vectors (10 m above ground) calculated for the selected days for Pula-Airport, 1999–2002. Wind steadiness in % is given in parentheses for every hour. The dashed line represents the direction of the local western coastline. From 01:00 to 05:00 LST every second hour is shown for clarity.

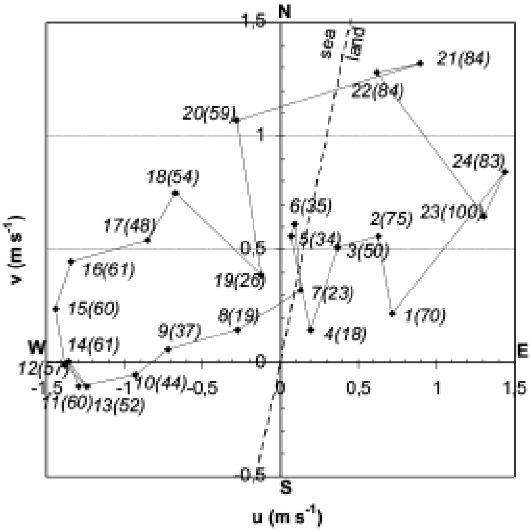

Figure 4. Same as Figure 3 except for Omišalj.

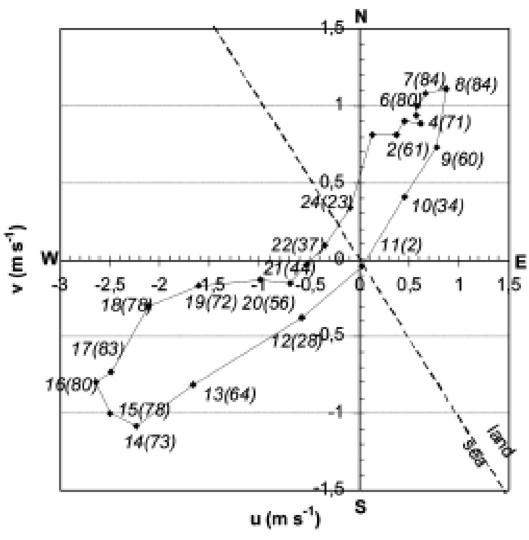

Figure 5. Same as Figure 3 except for Mali Lošinj.

12:00 LST) demonstrate a period of change between land and sea breeze regimes, when the lowest steadiness occurs. In the afternoon, at the Pula and Mali Lošinj stations, a sea breeze from SW-WSW builds up, and wind speeds are approximately 40% higher (~2.5 m s^{-1}) than land breeze speeds. At the Omišalj station, daytime western winds blow for near 10 hours and are approximately of the same order of magnitude as the nocturnal winds (Table 1).

The reason for the very late incoming of the onshore flow at Pula is the position of the station at the tip of the Istrian Peninsula, where an interaction among sea breeze circulations can happen very easily. Therefore, sea breezes from the south and/or east directions can suppress the onshore flow from the west at the beginning of the day (see Figure 2a). Since the *Etesian* has a very important role during the summer over the Northern Adriatic, this steady NW wind is superimposed to the local flow and, during the day, the west flow overcomes other local circulations.

Also, it is well known that the size and geometry of the islands play an important role in the determination of their sea/land breeze circulations (Mahrer and Segal, 1985). A sea breeze on one side can be regarded as a land breeze on the other side. Similar to the Pula station, the sea breeze development at Omišalj and Mali Lošinj starts late, around noon. A narrow island zone generates sea breezes on the NE-E and SW-W parts of both islands at the same time in the morning. An interaction between these breezes is registered at the stations as a very light wind with small steadiness (up to 11:00 LST at Omišalj in Figure 4 and up to 12:00 LST for Mali Lošinj in Figure 5). This is in agreement with Xian and Pielke (1991) who suggested that sea breeze cells over smaller landmasses usually meet before 12:00 LST and the intensity of the finally merged sea breezes is weak.

Unfortunately, due to some technical difficulties at the Omišalj station, the number of nighttime measurements is smaller than the measurements during daytime hours.

Another insular station is Rab, where 60% of the days have local circulations. The hodograph shows a quite regular sea/land breeze regime (Figure 6). Nighttime velocities less then 1 m s^{-1} from NE diminish in the early morning hours. The sea breeze, which is predominantly SW, starts at 8:00 LST. It lasts for nearly 10 hours, reaching threefold higher wind speeds than the nocturnal ones (Table 1). The daily arrangement of directions is very similar to the Mali Lošinj directions (compare Figs. 5, 6). Since the island of Rab has a larger area than the island of Lošinj, the onshore flow begins earlier, without the merging of several sea breezes.

Another group of hodographs with CR (Figures 7, 8) are connected with stations situated at the foot of mountains. Thus, high mountains (Učka) rise behind the Opatija station, and the Rijeka station is situated in the northern part of town, in a hilly area (Fig. 1). At these sites, a combination of land/sea breezes with downslope/upslope winds should be expected.

As seen from Figure 7, nighttime wind vectors (19:00 to 06:00 LST) are from W-WNW, i.e. almost perpendicular to the shore. The speeds of the land breeze are surprisingly low, about 0.5 m s^{-1}, despite the fact that a superposition of land and downslope breezes exists. The sea breeze starts to blow toward the coastline after 07:00 LST. This relatively early beginning of local winds, influenced by the hinterland, is continued with the strengthening of the sea and upslope breezes (from SSE) during the afternoon hours until

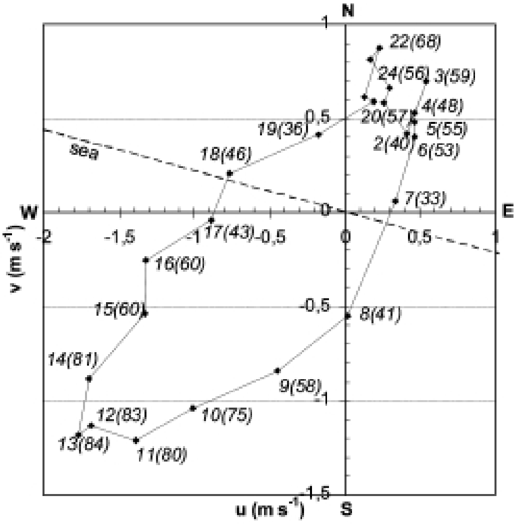

Figure 6. Same as Figure 3 except for Rab.

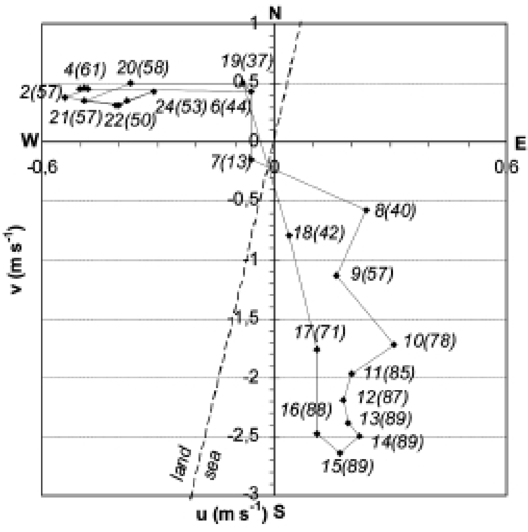

Figure 7. Same as Figure 3 except for Opatija.

18:00 LST. Wind velocities are about 2.5 m s^{-1}, which is almost six times stronger than the nighttime values, and they are steady (about 80%). Since Opatija is situated near the deepest indentation of the Adriatic Sea in the Kvarner Bay, where there is a moderate depression between the Učka, Snežnik and Risnjak mountains, this pass maintains and enhances the diurnal winds from SSE direction.

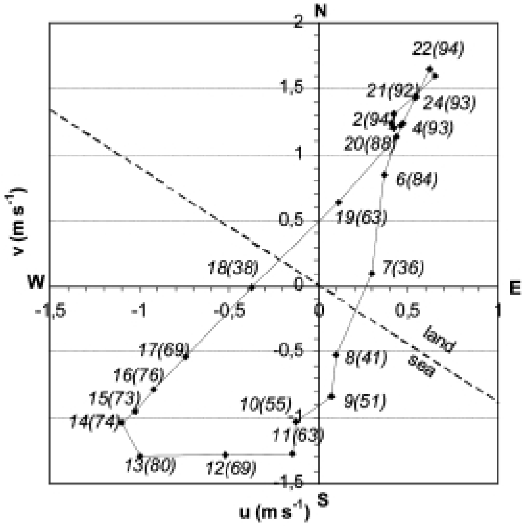

Figure 8. Same as Figure 3 except for Rijeka.

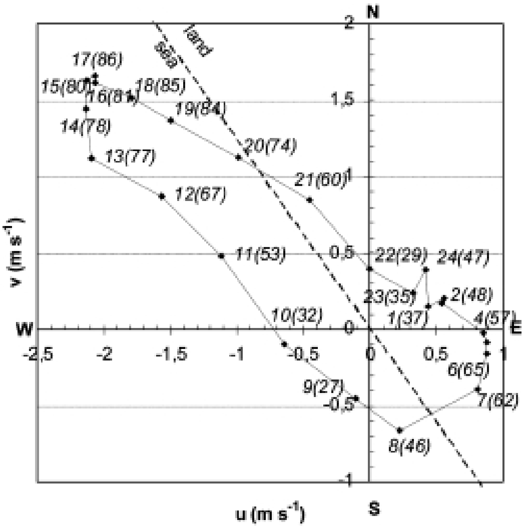

Figure 9. Same as Figure 3 except for Zadar.

In Figure 8, the wind vectors are from NE directions during the night (19:00 to 07:00 LST). The wind velocities, which correspond to a combination of land breeze and downslope wind, are about 1.5 m s^{-1} and the steadiness is considerable (more than 80%). After a short calm, a diurnal wind, as a superposition to the sea breeze and upslope flow, starts to blow from SW. These diurnal onshore winds are almost of the same speed as the nocturnal winds and they last more than 10 hours (Table 1).

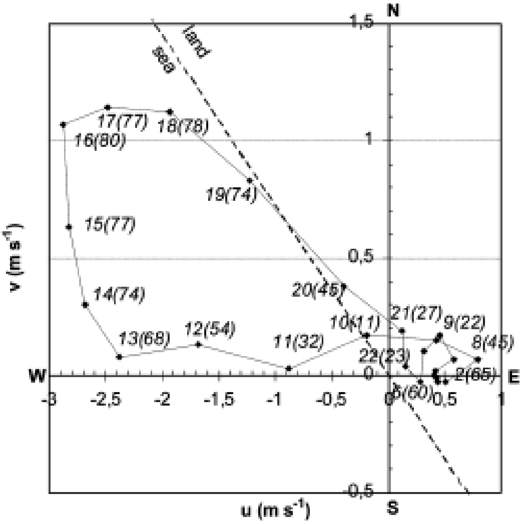

Figure 10. Same as Figure 3 except for Zadar-airport.

The remaining stations with CR hodographs (Figures 9, 10) are in Zadar, which is located in Northern Dalmatia, with a flat hinterland and at Zadar-airport, 8 km inland from Zadar (Fig.1). The Zadar station, 30 m away from the coastline, is separated from the open sea by the Zadar Archipelago and the Zadar Peninsula. From 22:00 to 7:00 LST, the prevailing offshore directions at both stations are eastern, with relatively high steadiness and rather low velocities (Figs. 9, 10). Onshore winds commence at 09:00 LST in Fig. 9 but at Zadar-airport, the onset of the sea breeze does not happen before 12:00 LST (Fig. 10). This means that the sea breeze needs to develop and reach the station. At first, at both stations, the winds are perpendicular to the shore as a weak western flow. Stronger daytime winds (about 2.5 m s^{-1}) start after 12:00 LST, when steadiness is higher than 50%. The location of the Zadar Peninsula has an additional influence on the diurnal hodograph for the coastal station (Fig. 9), which can be seen in the elongated hodograph and high steadiness at 20:00 and 21:00 LST, when the sea breeze starts to diminish. Lukšić (1996) analyzed the wind regime at this station for three climatological terms and also pointed out the high frequency of NW winds at 14:00 LST, which agrees with the above result. Although diurnal wind velocities at Zadar and Zadar-Airport are almost the same, the difference between the two hodographs is in their shape. Due to the channelling effect, the hodograph for Zadar is like a very elongated ellipse, while the one for Zadar-airport has a more circular shape during the day.

The stations with ACR hodographs are Senj and Malinska. The Senj station (Fig. 1), located 250 m inland, in the northern part of town, is situated on the borderline between two mountains – Velebit and Kapela. Due to its

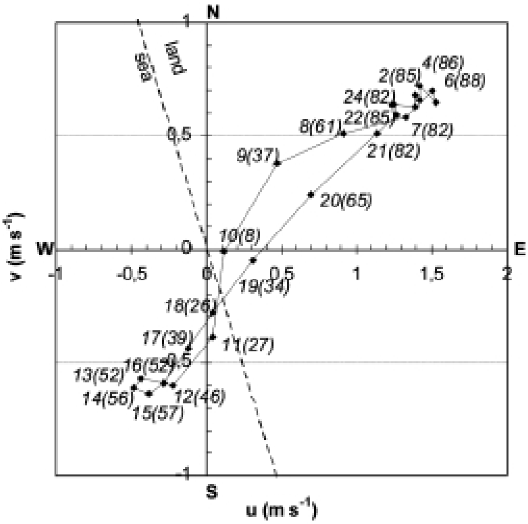

Figure 11. Same as Figure 3 except for Senj.

geographical position, the air current is often channelled across the Vratnik pass. The Malinska station is situated on the NW shore of the largest island of the Kvarner Archipelago, Krk.

Lukšić (1989) already examined the diurnal behaviour of the summer wind vectors in Senj, but he used very restrictive filters and, consequently, selected only 30 days from 1959–1967. In the meantime, the station was moved to a neighbouring location. Therefore, in this study a reanalysis has been done and the hodograph is depicted in Figure 11. During the night (20:00 to 09:00 LST), the average wind vectors in Senj are from NE, with high steadiness, representing the joined land breeze, downslope and mountain winds. A twice-weaker diurnal SSW flow represents the coupled sea and upslope breezes. Here, for several reasons, a relatively low portion of sea/land breeze days and double nocturnal velocities can be noticed. The *bora* wind is very frequent at this station during the warm part of the year, which generally agrees with Lukšić (1989), and there is channelling effect between Krk and the mainland (Fig. 2a). Furthermore, this station has already been recognized as a station with unusual ACW veering during the day (Orlić et al., 1988, Lukšić, 1989). In Figure 11, a slight predominance of ACW can be noted, which is in agreement with Orlić et al. (1988), where the authors found that the ACW is insignificantly higher than its clockwise counterpart. They also concluded that the alongshore pressure gradient is presumably responsible for the enlargement of the anticlockwise pattern of diurnal breezes at the Senj station.

In Figure 12, for the Malinska station, the nocturnal wind vectors (19:00 to 07:00 LST) are from SE, and they blow perpendicular to the shore with al-

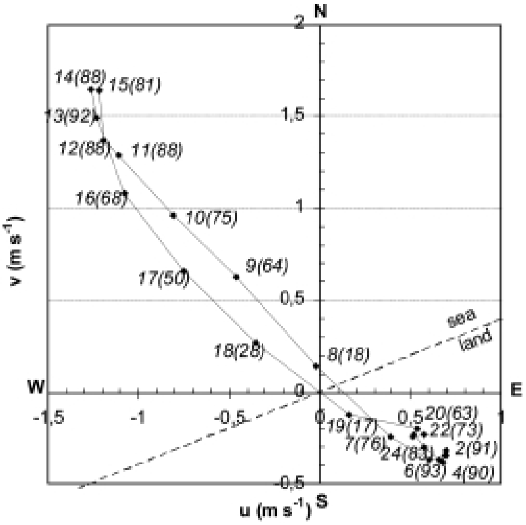

Figure 12. Same as Figure 3 except for Malinska.

most 90% steadiness. They are rather weak. After a short calm at 08:00 LST, a sea breeze starts to develop from NW. Velocities increase up to 2 m s^{-1} and the onshore flow blows for nearly 10 hours (Table 1). The daytime flow values are three times higher then the nighttime ones. With the Senj station, this is another example of unusual ACW turning, even more prominent, which has not been observed until now.

If the results are shown separately for June and July, and for August and September for both stations, it can be seen that, in the second part of summer, more favourable conditions for ACW rotation are formed in Senj (Figure 13), while the opposite applies to Malinska (Figure 14). In Malinska, the hodograph for the June and July ACW is clearly visible (Figure 14a). However, the hodograph in the second part of summer does not show an ACW trend of turning (Figure 14b). A plausible cause would be the influence of the »bay« circulation which develops according to Lukšić (1989) over the Kvarner, east of the Istrian Peninsula. The »bay« circulation appears because of the significant island surface. During daytime, the air temperature in this area increases compared to the air temperature south of it, while it reduces at night. The lower air layer of the »bay« circulation moves from south towards the bay around mid-day and in the opposite direction during the night (Fig. 2). Lukšić (1989) found that the favourable conditions for »bay« circulation are in July. The »bay« circulation influences the local pressure gradients which maintain the ACW behaviour at Malinska. The »bay« circulation in Senj has a direction parallel to the coast – SSE during daytime and NNW at night. Contrary to Malinska, the ACW turning at Senj is registered more frequently when the »bay« circulation is weak or does not exist. Therefore, in

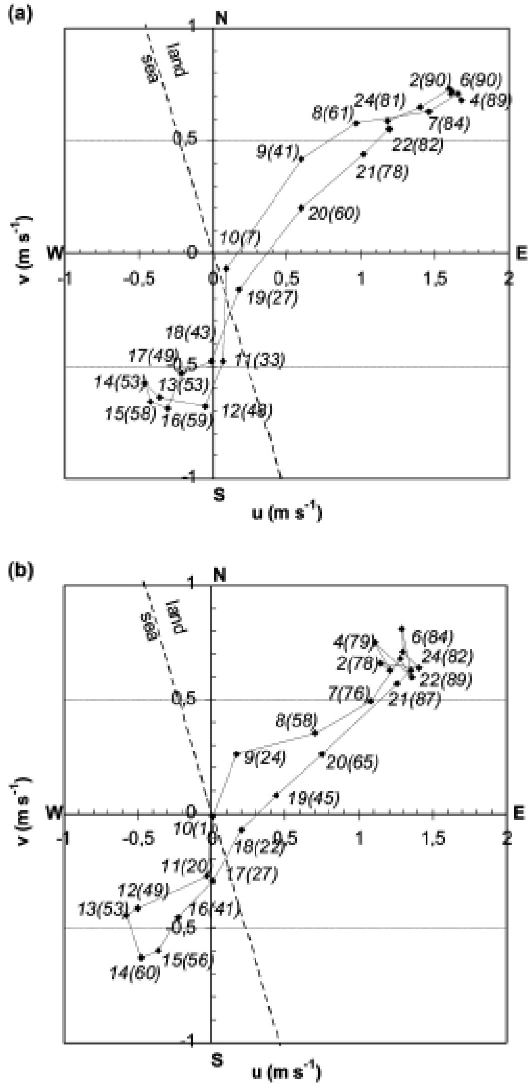

Figure 13. Same as Figure 3 except for Senj (a) June and July; and (b) August and September.

August and September the ACW in Senj is more pronounced. Although the set of measurements is small, in a climatological sense, the author thinks that it is large enough to demonstrate the influence of the diurnal periodic circulation system of a larger scale on the local sea/land breeze circulations.

The above results reveal the significant role of the local topography on sea breeze circulations. The same has been also confirmed by several numerical test results which were performed for three separate cases as follows:

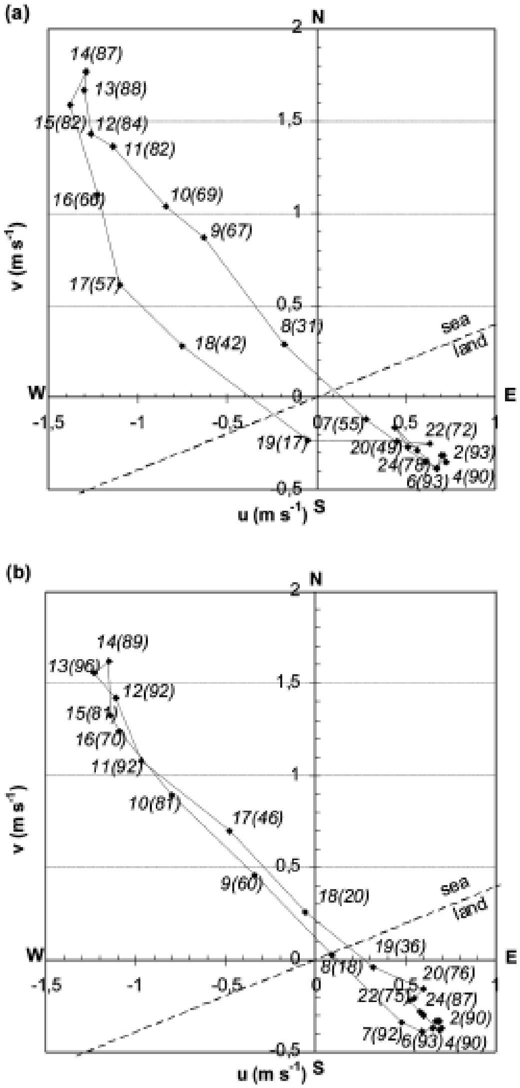

Figure 14. Same as Figure 3 except for Malinska (a) June and July; and (b) August and September.

1) a simulation of a real case (18–20, June 2000) extracted from the filtered data set (i.e. topography and synoptic forcing; *test 1*)

2) a simulation without synoptic forcing (*test 2*)

3) a simulation without topography forcing (i.e. maximum height of the ground surface was 10 m; *test 3*)

The simulations were performed with the three-dimensional non-hydrostatic meso-scale model MEMO6 (Moussiopoulos, 1994, Kunz and Moussio-

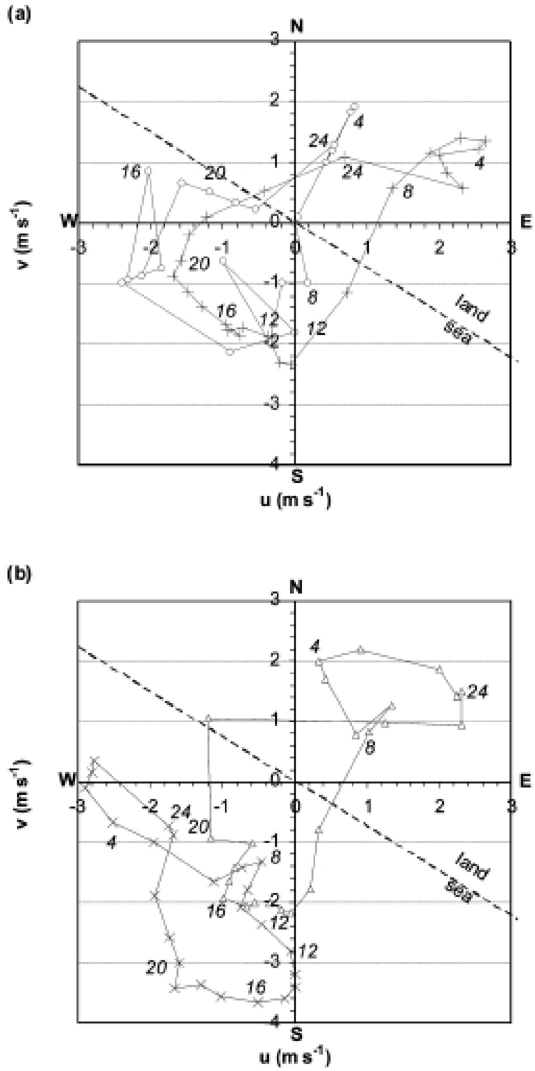

Figure 15. Surface hodographs for the Rijeka station on 20 June 2000 for (a) measured wind vectors (circles) and predicted wind vectors for test 1 (real case; crosses); (b) test 2 (without synoptic forcing; triangles) and test 3 (without topography; stars) (see text for details). The dashed line represents the direction of the coastline. Every fourth hour is shown for clarity.

poulos, 1995). Only one example (20 June 2000) is shown here as an illustration for the Rijeka station (Figure 15). This date was chosen because the daily hodograph (measurements) is of a very similar shape compared with the average hodograph for Rijeka (compare Figures 8, 15a). It can be seen that the difference in synoptic forcing has a much smaller impact on the hodograph's shape than the topographic effect (Figure 15b).

4. Conclusions

Since the sea/land breezes along the Northern Adriatic eastern coast have still not been completely examined, an investigation of the average daily wind regime at the 10 chosen meteorological stations can be a contribution to this goal. Although Orlić et al. (1988) pointed out that land-sea temperature gradients are reduced by the number of islands in the North Adriatic, the results of this study demonstrate that sea/land breezes can be detected quite often during the summer (Table 1). However, a very complicated topography influences the hodograph shapes. The results reveal two stations with ACR (Malinska and Senj) and stations where local circulations interact giving, thus, distorted hodographs. Except for the Senj station, which has the lowest frequency of sea breeze days, all stations have frequent local circulation (see Table 1), which agrees with other mid-latitude locations such as Mallorca (Ramis and Romero, 1995) or Sardinia (Furberg et al., 2002). At stations where an interaction between slope winds and sea/land breeze exists (Opatija and Rijeka), and at the Rab and Zadar-Airport stations, the frequency is about 60%. The observed times of onset and cessation show a duration of at least 7 hours. This is also comparable to other studies for mid-latitude locations, *e.g.,* Sardinia, where the average sea breeze duration reaches a maximum of about 9 hours in the summer months (Furberg et al., 2002). In contrast to the Senj station, the average onshore wind speeds at all stations are twice stronger than their offshore counterpart (daytime 2 m s^{-1} versus night-time 1 m s^{-1}). The hodographs for Pula, Omišalj and Mali Lošinj display a later onset of the prevailing sea breeze because of the interaction among several sea breeze circulations. Furthermore, the results for Opatija, Senj and Zadar show distorted hodographs because of the channelling effect. Such a big topographic and coastline influence should be expected because of the chosen period of study and the nature of the filters used. Summer months and anticyclonic situations are responsible for the hodograph characteristics, which appear to be driven by scales of the order of a few tens of kilometres.

Due to the shortness of data sequences, these should be considered as preliminary results of the average hodographs. For statistically climatologically representative results, a longer data set is desirable. The author also thinks that these results could be the basis for the validation of the three-dimensional model simulating the atmospheric processes over the Northern Adriatic area.

Acknowledgments – The author is indebted to the Croatian Hydrological and Meteorological Service and to the Meteorological Department of Croatia Control at Zagreb Airport for providing the meteorological data for this study. The author is grateful to Dr. Zvjezdana Bencetić Klaić of the Department of Geophysics, Faculty of Science, Zagreb, Croatia for her constructive comments. This work has been supported by the Ministry of Science and Technology (Project num. 0119330).

References

Borne, K., Chen, D. and Nunez, M. (1998): A method for finding sea breeze days under stable synoptic conditions and its application to the Swedish west coast. Int. J. Climat., **18**, 901–914.

Baker, R.D., Lynn, B.H., Boone, A., Tao, W.K., and Simpson, J. (2001): The influence of soil moisture, coastline curvature, and land-breeze circulations on sea-breeze-initiated precipitation. J. Hydrometeorol., **2**, 193–211.

Furberg, M., Steyn, D.G., and Baldi, M. (2002): The climatology of sea breezes on Sardinia. Int. J. Climat., **22**, 917–932.

Kunz, R., and Moussiopoulos, N. (1995): Simulation of the wind field in Athens using refined boundary conditions. Atmos. Environ., **29**, 3575–3591.

Lukšić, I. (1989): Diurnal winds at Senj. (In Croatian) Geofizika **6**, 59–74.

Lukšić, I. (1996): Sea/land breeze on the Kornati Islands. (In Croatian) Cro. Meteorol. J., **31**, 103–119.

Mahrer, Y. and Segal, M. (1985): On the effects of island's geometry and size on inducing sea breeze circulation. Mon. Wea. Rev., **113**, 170–174.

Moussiopoulos, N. (ed.), 1994, The EUMAC zooming model: model structure and applications. Garmisch-Partenkirchen: EUROTRAC Special Publication, ISS, 266 pp.

Orlić, M., Penzar, B. and Penzar, I. (1988): Adriatic sea and land breezes: Clockwise versus anticlockwise rotation«, J. Appl. Meteorol., **27**, 675–679.

Penzar, B. (1976): The climates of Zagreb, Osijek, Rijeka and Split. Geographical papers 3, Školska knjiga, Zagreb, 195–224.

Penzar, B. (1977): »Wind« (in Croatian), Prilozi poznavanju vremena i klime SFRJ, 41–117.

Penzar, B. and Makjanić, B. (1978): *Introduction in climatology.* (In Croatian), Sveučilište u Zagrebu, Prirodoslovno-matematički fakultet, Zagreb, pp. 206.

Ramis, C. and Romero, R. (1995): A first numerical simulation of the development and structure of the sea breeze on the island of Mallorca. Annales Geophysicae, **13**, 981–994.

Simpson, J.E. (1994): *Sea breeze and local winds*. Cambridge University press, 234 pp.

Telišman Prtenjak, M. (1998/1999): A review of investigations of sea and land breezes along the Adriatic Coast of Croatia. Cro. Meteorol. J., **33/34**, 63–69.

Yan, H. and Anthes, R.A. (1988): The effect of variations in surface moisture on mesoscale circulations. Mon. Wea. Rev., **116**, 192–208.

Xian, Z. and Pielke, R.A. (1991): The effects of width of landmasses on the development of sea breezes. J. Appl. Met., **30**, 1280–1304.

SAŽETAK

Osnovna svojstva obalne cirkulacije duž istočne obale sjevernog Jadrana

Maja Telišman Prtenjak

Uzduž sjevernog Jadrana, ispitan je srednji dnevni režim vjetra na 10 meteoroloških postaja u slučaju pojavljivanja lokalne obalne cirkulacije u ljetnom periodu. Odabrane postaje su: Pula-aerodrom, Opatija, Rijeka, Senj, Malinska, Omišalj (Rijeka-aerodrom), Mali Lošinj, Rab, Zadar i Zadar-aerodrom. Cilj je bio ispitati učestalost pojave obalne cirkulacije, vrijeme početka i završetka danjeg dijela te prosječno trajanje dnevnog i noćnog dijela obalne cirkulacije kao i utjecaj Coriolisove sile na rotaciju vektora na odabranim postajama. Rezultati su usporedivi s odgovarajućim rezultatima proučavanja za lokacije umjerenih geografskih širina. Na dvije postaje uočena je rotacija u smjeru suprotnom od kazaljke na satu (Malinska i Senj), dok su ostale postaje pokazale zakretanje u smjeru kazaljke na satu koje je uobičajeno za sjevernoj hemisferi.

Ključne riječi: dnevna grana obalne cirkulacije, noćna grana obalne cirkulacije, sjeverni Jadran

Corresponding author's address: Maja Telišman Prtenjak, Andrija Mohorovičić Geophysical Institute, Faculty of Science, University of Zagreb, Horvatovac bb, 10000 Zagreb, Croatia, e-mail: telisman@rudjer.irb.hr.