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WIND CONDITIONS IN THE KRKONOŠE MOUNTAINS

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SHRNUTÍ

VĚTRNÉ POMĚRY V KRKONOŠÍCH

V článku jsou analyzovány větrné poměry v české části Krkonoš v období 1964 – 68. Bližší popis použitých stanic je uveden v tab. 1. Pozorování větru v jednotlivých termínech bylo zpracováno podle ročních období a za celý rok do osmisměrových větrných růžic, pokud to dovolovala kvalita pozorování, bylo též přihlédnuto k rychlosti větru (viz tab. 2, obr. 1 – 3). Bylo zjištěno, že ve vrcholových partiích převládá západní a jihozápadní směr větru, v podhůří pak vesměs západní vítr. V horských údolích je směr větru terénem nejvíce modifikován.

Proto byla na větrné poměry v údolích aplikována Defantova teorie (obr. 4). Pro Harrachov a Benecko byl zpracován denní chod směru větru podle pozorování v 7, 14 a 21 hodin. V úvahu byly vzaty jen dny s anticyklonální povětrnostní situací. Výsledky (viz tab. 3, obr. 5, 6) jsou s teoretickou prací v dobré shodě.

Závěrem byla věnována pozornost větru při současném výskytu mlhy. Z výsledků (tab. 4, obr. 7) jsou markantně patrny diamentrální rozdíly, které jsou podmíněny rozdílnými příčinami vzniku mlhy v nižších polohách a na vrcholech. Zatímco na horách jsou při mlze pozorovány větry značných rychlostí, v nižších polohách zřetelně převládá bezvětří.

СОДЕРЖАНИЕ

ВЕТРОВОЙ РЕЖИМ В КРКОНОШАХ

В статье анализируется ветровой режим чешского участка Крконош за период 1964 до 1968 гг. Более подробное описание использованных станций приведено в таб. 1. Наблюдения ветра в отдельные сроки обработаны по сезонам и за весь год по восьми румбам, насколько качество наблюдений позволяло, учитывались также скорости ветра (см. таб. 2, рис. 1—3). Выявлено, что на вершинах преобладает западное и югозападное направления ветра и в подгорной местности — в большинстве случаев западный ветер. В горных долинах направление ветра модифицируется местностью более всего.

Поэтому к ветровому режиму долин применена теория Дефанта (рис. 4). Для Гарраxова и Бенецко суточный ход ветра обработан по наблюдениям в 7, 14 и 21 час. Учитывались только дни с антициклоническим положением погоды. Результаты (см. таб. 3, рис. 5, 6) хорошо соглашаются с теоретической работой.

В заключении уделялось внимание ветру при одновременном появлении тумана. Из результатов (таб. 4, рис. 7) ярко заметны большие различия, обусловленные различными причинами возникновения тумана на более низких уровнях и на вершинах. Между тем как в горах при туманах наблюдаются ветры больших скоростей, на более низких уровнях заметно преобладает штиль.

1. INTRODUCTION

The investigations of wind conditions have its importance in climatology, because they have their significance and their exploitation is many-sided. A number of articles and publications have already treated these investigations. However, with a view to the variability of the terrain in the ČSSR the investigations do not cover the whole territory which applies, in particular to Bohemia and Moravia. In some cases a more detailed study is hindered by the low density of points of observation and by the necessity to use results which were obtained by voluntary observers, i.e., mostly lacking instrumental equipment.

In the present investigation we tried to obtain at least an outline of the local climate of wind conditions on the Czech side of the Krkonoše Mts. and, apart from current surveys, also to observe some of the specific peculiarities. The results may even have an economic significance and may serve for recreational and touristic purposes.

The wind conditions in the Krkonoše Mts. were analysed using the observations of voluntary stations of the network of the Hydrometeorological Institute (HMI), made in the period 1964—1967. The ridges and peak regions are represented by station Vítkovice, Vrbatova chata, in the valleys obser-

Table 1 — **List of stations**
Tab. 1 — **Seznam stanic**
Таб. 1 — **Список станций**

Name Jméno Имя	Coordinates Souřadnice Координаты		Height Výška Высота	Place Umístění Поместение
Vítkovice, Vrbatova chata	15°33′E	50°45′N	1410 m	flat ridge plochý hřeben плоский хребет
Benecko	15°34′E	50°40′N	880 m	SW slope of S—N valley JZ svah severojižního údolí ЮЗ склон североюжной долины
Harrachov	15°27′E	50°47′N	670 m	bottom of E—W valley dno východo-západního údolí дно восточно-западной долины
Pec pod Sněžkou	15°44′E	50°42′N	805 m	S slope of basin J svah kotliny Ю склон котловины
Trutnov	15°55′E	50°33′N	427 m	foothill podhůří подгорная местность
Vysoké nad Jizerou	15°24′E	50°47′N	690 m	hill in foothill pahorek v podhůří холм в подгорной местности

vations from Harrachov, Benecko and Pec pod Sněžkou were used, and finally in the foothills observations were also provided by stations in Vysoké nad Jizerou and Trutnov. More detailed data on the stations whose observations were used, can be found in Tab. 1.

All stations which made observations in the Krkonoše Mts. in the above mentioned period, were considered in investigating of the wind conditions. The observations were made in accordance with the regulations of the HMI, the direction of the wind was determined by means of a sixteen-point windvane, and the wind speed was estimated by reducing the Beaufort scale to the metric system. The station Vítkovice, Vrbatova chata was equipped by Metra-type manual anemometers at the time. The observed results were subject to professional supervision of the HMI.

2. FREQUENCY OF WIND DIRECTION

A mountain range affects the direction and speed of the wind. In general, the range has the effect of an obstacle; in this way windward and leeward regions are formed, either in the general climatological sense, or from the point of view of the instantaneous weather situation. The fundamental flow pattern above a homogeneous, plane terrain is thus perturbed. The relative relief of the surface causes increased friction which is reflected by increased dynamic turbulence in the lower layer of the atmosphere. The effect of friction decreases with height; that is why the wind conditions on isolated peaks are very close to those in the free atmosphere.

The investigation was based on the four seasons; the direction of the wind was as usual classified into the eight principal directions, taking into account at the same time the wind speed with the following intervals 1 m/s and less, 2 to 8 m/s, 9 m/s and more. Occurences of calm were classified separately. However, the observations of the wind speed at some stations were subject to such errors that they could not be considered; the errors were reflected in overestimating, as well as underestimating the wind speed. The number of calm periods can be determined with difficulties, however it is impossible to determine the number of cases when the wind had a higher speed. For this reason we were forced to restrict in some cases our analyses of the frequency of the wind direction. All the results were summarized in Tab. 2.

In the highest mountains observations were carried out at the Vítkovice, Vrbatova chata station. The authors consider its results representative of the wind conditions of the Krkonoše ridge, particularly in their western part. (See Fig. 1). As can be seen from the table, south-westerly wind is predominant here throughout the whole year, its frequency is to about 25 %. The westerly direction displayes secondary minima in the autumn and in winter, the north-easterly in spring and summer. The number of calm periods is least in summer, which seems to be due to the best developed system of local winds with respect to the maximum intensity of incoming solar radiation and the largest physical differences of the active surfaces. The system of local winds does not usually reach higher speeds, and that is why the wind group with a speed of 1 m/s displays the highest frequency here throughout all the seasons of the year. The number of calm periods in winter is smaller than at the valley stations, because the station is frequently located above an inversion layer.

Table 2 **Frequency distribution of wind direction**
Tab. 2 **Četnostní rozdělení směru větru**
Таб. 2 **Повторяемость распределения направлений ветра**

wind speed m/sec rychlost větru m/s скорость ветра м/сек	N	NE	E	SE	S	SW	W	NW	calm	Σ
	Vítkovice, Vrbatova chata									
spring – jaro – весна										
1	0,80	1,16	0,65	0,94	0,65	1,09	0,80	0,65		6,74
2–8	7,61	10,07	3,84	2,46	6,01	16,09	9,06	8,12		64,26
≧ 9	3,77	5,00	1,30	0,07	1,74	6,01	2,97	3,41		24,28
Σ	12,17	16,23	5,80	3,48	8,41	23,19	12,83	12,17	5,72	–
summer – léto – лето										
1	0,65	1,81	1,01	0,43	1,81	3,70	2,39	0,29		12,10
2–8	8,41	12,97	4,28	2,46	6,09	20,36	11,74	9,06		75,36
≧ 9	1,23	2,90	0,36	.	0,36	2,24	1,01	0,58		8,70
Σ	10,29	17,68	5,65	2,90	8,26	26,30	15,14	9,93	3,84	–
autumn – podzim – осень										
1	0,51	1,10	0,88	0,73	2,20	2,34	1,68	0,29		9,74
2–8	5,57	7,25	2,93	2,71	8,35	25,35	12,53	6,08		70,77
≧ 9	1,76	2,34	0,73	0,44	1,68	4,18	2,49	0,51		14,14
Σ	7,84	10,70	4,54	3,88	12,23	31,87	16,70	6,89	5,35	–
winter – zima – зима										
1	0,59	0,96	0,66	1,03	1,40	1,40	0,59	0,29		6,93
2–8	7,60	6,27	2,73	2,21	4,50	15,56	13,13	7,82		59,81
≧ 9	5,09	6,12	0,44	0,15	2,18	7,82	4,87	2,88		28,54
Σ	13,35	13,42	3,83	3,39	7,08	24,78	18,58	10,99	4,72	–
year – rok – год										
1	0,64	1,26	0,82	0,77	1,51	2,13	1,37	0,38		8,89
2–8	7,30	9,16	3,45	2,48	6,22	19,34	11,62	7,75		67,32
≧ 9	2,96	4,09	0,73	0,16	1,26	5,04	2,83	1,82		18,88
Σ	10,89	14,50	5,00	3,41	8,99	26,51	15,82	9,96	4,91	–
	Benecko									
spring – jaro – весна										
1	0,22	0,51	0,22	0,43	0,29	0,15	0,15	0,65		2,61
2—8	4,71	15,72	7,61	16,45	4,57	8,84	6,67	14,93		79,49
≧ 9	1,38	2,25	0,29	2,83	0,36	0,29	0,43	4,93		12,75
Σ	6,30	18,48	8,11	19,71	5,22	9,28	7,25	20,51	5,14	—
summer – léto – лето										
1	0,43	1,09	0,58	0,51	0,15	0,43	0,58	0,43		4,20
2—8	5,14	19,10	9,06	13,26	5,80	10,65	5,29	14,28		82,61
≧ 9	0,22	1,09	0,29	1,55	0,15	0,51	0,15	1,88		5,72
Σ	5,80	21,30	9,93	15,22	6,09	11,59	6,01	16,59	7,46	—
autumn – podzim – осень										
1	0,15	1,54	0,51	0,44	0,44	0,73	0,51	0,37		4,69
2—8	2,05	14,51	7,25	19,19	5,20	9,08	4,62	13,04		74,95
≧ 9	0,07	0,73	1,32	5,49	0,22	0,66	0,44	3,00		11,94
Σ	2,27	16,78	9,08	25,13	5,86	10,48	5,57	16,41	8,42	—

wind speed m/sec rychlost větru m/s скорость ветра м/сек	N	NE	E	SE	S	SW	W	NW	calm	Σ
winter – zima – зима										
1	0,37	0,66	0,47	0,74	0,15	0,37	0,37	1,40		4,50
2—8	2,65	10,10	6,19	15,41	2,58	5,60	4,87	21,09		68,51
≧9	0,74	0,88	0,66	4,72	0,29	0,22	0,29	7,60		15,41
Σ	3,76	11,65	7,30	20,87	3,02	6,19	5,53	30,09	11,58	—
year – rok – год										
1	0,29	0,95	0,44	0,53	0,26	0,42	0,40	0,71		4,00
2—8	3,63	13,08	7,52	16,07	4,56	8,56	5,36	15,82		76,43
≧9	0,60	1,24	0,67	3,61	0,27	0,40	0,33	4,34		11,44
Σ	4,52	17,10	8,59	20,22	5,09	9,38	6,09	20,87	8,14	—
	Harrachov									
spring – jaro – весна ×	4,71	10,51	28,84	10,94	5,00	8,91	15,29	12,90	2,90	—
summer – léto – лето ×	5,14	8,77	29,13	9,56	5,29	6,81	14,07	13,70	7,54	—
autumn – podzim – осень ×	3,22	7,69	30,04	9,90	8,06	8,06	14,51	10,11	8,42	—
winter – zima – зима ×	4,65	6,64	27,06	10,29	4,94	9,29	16,37	16,52	4,50	—
year – rok – год ×	4,42	8,43	28,81	10,07	5,82	8,25	15,07	13,20	5,84	—
	Pec pod Sněžkou									
spring – jaro – весна ×	6,01	6,37	13,26	10,14	10,22	11,16	24,28	5,87	12,46	—
summer – léto – лето ×	5,80	6,52	11,74	9,35	11,09	10,22	24,78	5,22	15,29	—
autumn – podzim – осень ×	3,59	6,81	13,70	11,06	14,51	10,33	23,59	6,74	9,67	—
winter – zima – зима ×	4,87	8,33	11,36	7,96	9,37	10,47	29,79	8,41	7,45	—
year – rok – год ×	5,05	7,48	12,52	9,69	11,31	10,56	25,60	6,55	11,24	—
	Trutnov									
spring – jaro – весна										
1	0,65	2,68	2,83	1,23	1,01	1,52	2,54	1,38		13,84
2—8	1,01	8,77	13,19	6,09	2,25	6,52	15,36	5,00		58,19
≧9	0,65	3,33	1,09	0,72	0,51	2,39	5,80	2,17		16,67
Σ	2,32	14,78	17,10	8,04	3,77	10,43	23,70	8,55	11,30	—
summer – léto – лето										
1	0,65	2,90	3,04	1,74	1,23	3,12	4,64	1,38		18,70
2—8	1,59	10,43	9,42	5,43	3,48	10,00	14,57	5,14		60,07
≧9	0,14	1,38	0,94	0,51	0,36	1,96	4,86	0,51		10,65
Σ	2,39	14,71	13,41	7,68	5,07	15,07	24,06	7,63	10,58	—

(Pokračování)

wind speed m/sec rychlost větru m/s скорость ветра м/сек	N	NE	E	SE	S	SW	W	NW	calm	Σ
autumn – podzim – осень										
1	0,66	4,84	3,22	1,90	1,17	2,71	4,03	1,17		19,71
2—8	1,25	11,21	9,16	5,57	3,52	12,09	12,82	5,81		59,41
≧9	0,15	2,20	0,66	0,37	0,15	1,76	4,25	0,22		9,74
Σ	2,05	18,24	13,04	7,84	4,84	16,56	21,10	5,20	11,14	—
winter – zima – зима										
1	1,19	2,61	2,22	1,58	1,03	2,05	3,96	2,45		17,89
2—8	1,66	5,38	5,94	4,20	2,69	14,09	18,45	7,52		59,94
≧9	0,08	1,98	1,35	0,40	0,32	1,43	5,30	1,58		12,43
Σ	2,93	9,97	9,50	6,18	4,04	18,37	27,71	11,56	9,74	—
year – rok – год										
1	0,76	3,29	2,84	1,61	1,10	2,56	3,77	1,60		17,52
2—8	1,37	9,02	9,50	5,35	2,97	10,63	15,22	5,33		59,39
≧9	0,28	2,21	1,02	0,50	0,32	1,89	5,05	1,11		12,38
Σ	2,41	14,51	13,36	7,46	4,38	15,09	24,03	8,04	10,71	—
	Vysoké nad Jizerou									
spring – jaro – весна ×	11,37	15,13	10,00	16,45	2,97	7,98	25,58	8,55	2,17	—
summer – léto – лето ×	11,59	17,83	11,67	12,54	5,58	10,36	19,64	7,18	3,62	—
autumn – podzim – осень ×	7,54	13,77	13,70	20,51	3,57	10,77	18,83	5,27	6,16	—
winter – zima – зима ×	7,08	10,40	11,21	20,79	1,70	5,17	34,07	5,31	4,27	—
year – rok – год ×	9,41	14,25	11,76	17,59	3,43	8,58	24,50	6,22	4,05	—

The largest frequency of winds with higher speeds (over 9 m/s) is in winter and spring. This is due to the frequent occurrence of larger horizontal air pressure gradients over Europe during these seasons. Besides, the frequent occurrence of inversions in valleys decreases the effect of friction at higher altitudes.

In the Krkonoše valleys the wind conditions are more complicated. Three stations were available here: Pec pod Sněžkou, Benecko and Harrachov (see Fig. 2). The wind conditions in the valleys represent the result of a series of effects which will be discussed briefly in the following section. A glance into the the table will show that the wind conditions differ considerably from place to place. Since wind speed observations of satisfactory accuracy are not available, a sufficiently detailed analysis could not be made. The considerable differences in the frequencies of various wind directions, as well as calm periods, yield the conclusion that the results obtained have a spatially limited validity. Different wind conditions would not only be found in other Krkonoše valleys, but even at other locations within these valleys, in which the observations were carried

out. This of course indicates that a detailed description of the wind conditions in mountain valleys, under the present state of observations and using the chosen method is impossible, and the given results only represent sporadic data on the wind conditions in mountain valleys.

In the foothills the wind conditions are affected by the range as a whole. Although one cannot exclude the existence of local thermal winds even here, or possibly the effects due to the location of the station in the field (valley, basin) which might cause a local deformation of the wind field, we are of the opinion that these contingencies are remote with a wiev to the locations of the relevant stations (Vysoké nad Jizerou, Trutnov). At both stations (see Fig. 3) westerly flow is markedly predominant throughout the whole year. The secondary maxima usually display an easterly component. This also agrees with the observations of the station in Vrchlabí, even though made during a different period. This indicates that westerly flow is clearly predominant in the Krkonoše foothills in the proximity of the mountains. The northerly and southerly directions, on the other hand, display low frequencies, and the number of calm periods increases with distance from the mountain range.

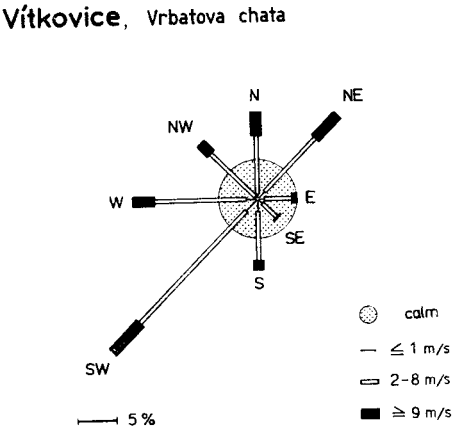


Fig. 1. Wind rose for ridge station

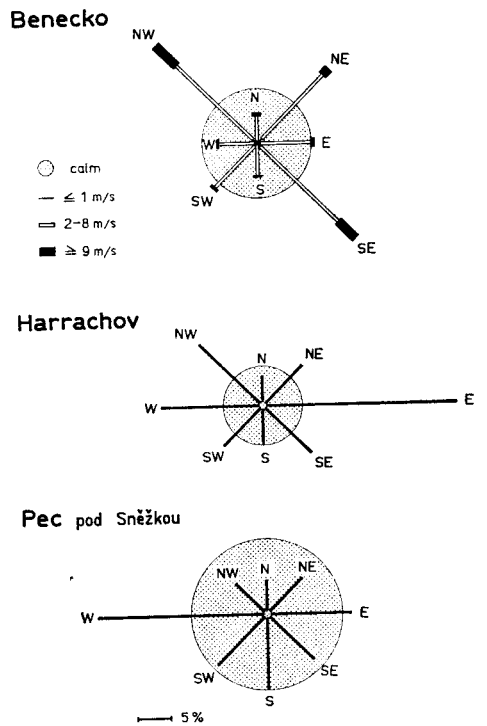


Fig. 2. Wind roses for valley stations

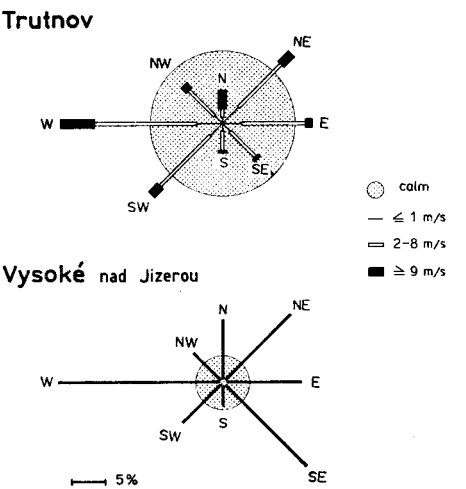


Fig. 3. Wind roses for foothill stations

If one investigates the changes in the wind frequency from season to season, will find certain regularities generally valid for the whole region of the Krkonoše Mts. In summer, as opposed to spring, the frequency of south-easterly and north-westerly flow decreases, but on the other hand, the occurence of southerly and south-westerly winds, as well as the frequency of calm periods, increase. This may be explained by typical summer circulation. The north-westerly circulation, typical of the spring, gradually subsides. In autumn,

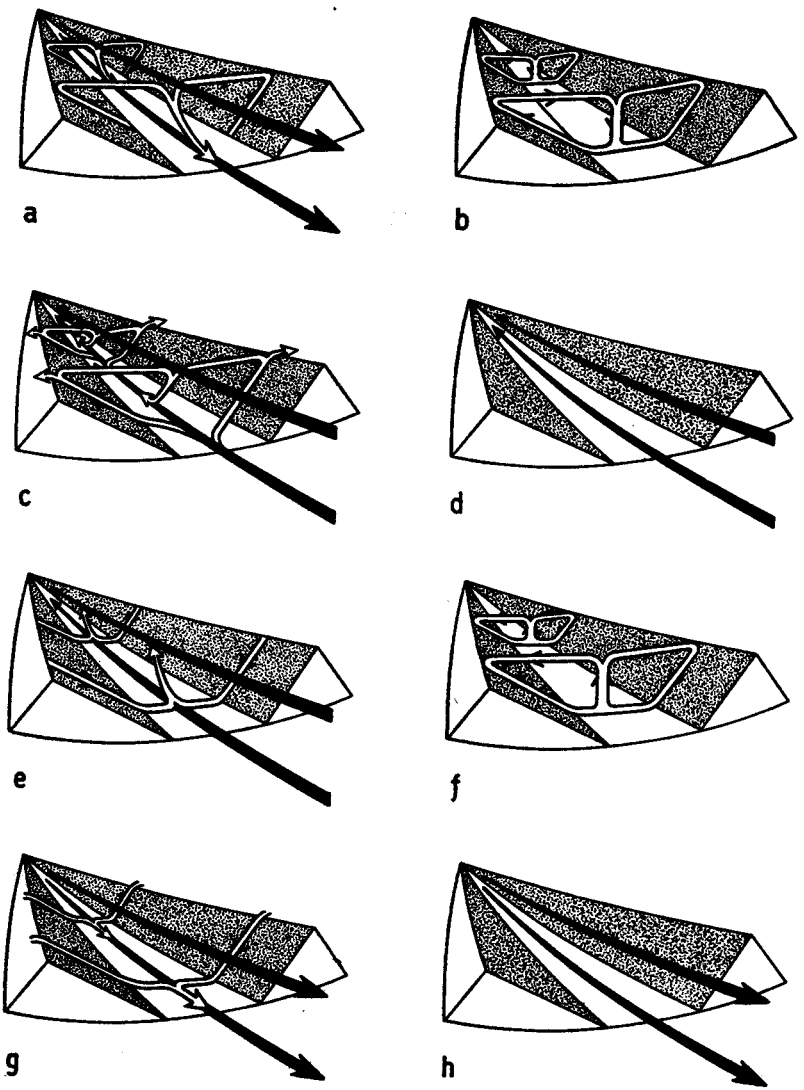


Fig. 4. Schematic illustration of the diurnal variations of the wind in a valley (after Defant) (a) sunrise (b) forenoon (c) noon and early afternoon (d) late afternoon (e) evening (f) early night (g) middle of night (h) late night

as oposed to the summer, there is an increase in the frequency of south-easterly and south-westerly flow, as well as of calm, but westerly, nort-westerly, northerly and north-easterly winds are observed less frequently. This phenomenon is apparently associated with the development of autumn highs. In winter the frequency of flow with an easterly component decreases, which also applies to southerly flow and calm. On the other hand, the frequency of westerly, north-westerly and westerly winds is increased. This represents typical symptoms of maritime effects with frequent westerly circulation. Finally, in spring the conditions revert to the circulation typical for a transient season of the years, the number frequency of westerly and north-westerly winds decreases, but on the other hand the frequency of winds with an easterly component increases together with that of northerly and southerly winds.

3. LOCAL CIRCULATION IN VALLEYS

As already mentioned earlier, the wind conditions in mountain valleys represent a synthesis of a whole series of effects. One of these is the modification of the direction and speed of the flow which originates without the moutain range. Of equal importance are the systems of slope winds, moutain and valley winds. Both these systems are generated by temperature and pressure differences. Their system was studied in detail, drawing on the conditions in the Alpine valleys, by DEFANT; it is schematically illustrated in Fig. 4. It should be pointed out that a necessary condition for generating these winds is the occurrence of a quasi-stationary region of high pressure in summer. Thus, these flows are typical of summer weather; they occur infrequently during the other seasons. Moreover, if they are included in the general wind system, they usually cause a sudden local change of direction of the wind. At the time of advection of air masses, which is associated with the large-scale wind system, local mountain effects of this type cannot originate.

Table 3 **The wind regime during anticyclonal situations (May—September)**
Tab. 3 **Proudění při anticyklonálních situacích (květen — září)**
Таб. 3 **Ветер при антициклонических положениях (май—сентябрь)**

time of observation pozorovací termín срок наблюдения	N	NE	E	SE	S	SW	W	NW	Calm
	Benecko								
07	4,79	19,81	15,34	18,85	4,15	5,43	4,47	11,50	15,65
14	3,51	7,35	4,15	16,93	15,34	26,52	10,88	13,74	1,60
21	4,47	31,63	22,04	24,92	2,24	1,28	1,60	7,67	4,15
	Harrachov								
07	2,56	8,95	25,56	8,31	2,56	6,71	16,93	9,58	18,85
14	7,35	9,90	23,68	9,58	8,95	12,78	15,34	10,86	2,56
21	4,15	10,86	52,08	12,46	3,51	3,19	4,47	5,43	3,83

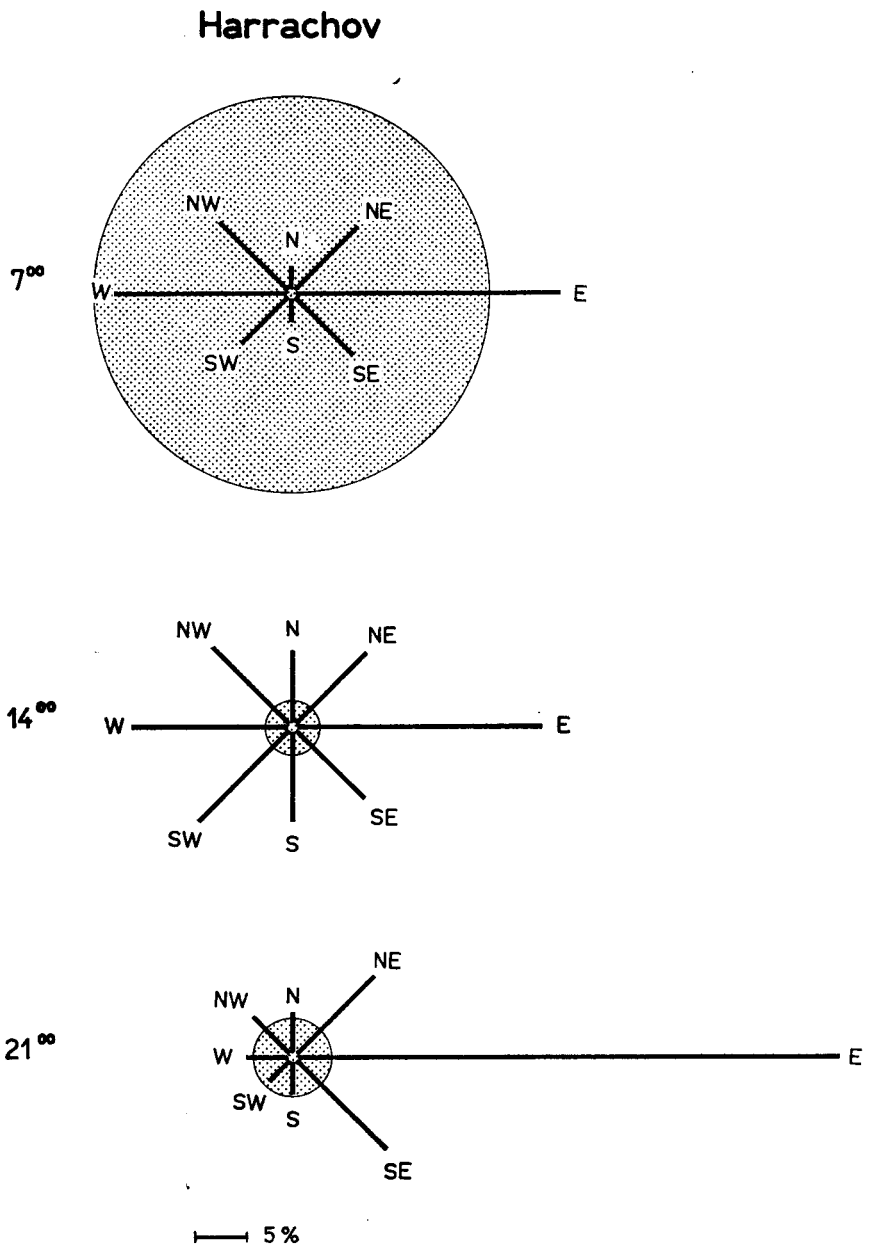


Fig. 5. Air currents in Mumlava valley in days with anticyclonal weather situations (May — September)

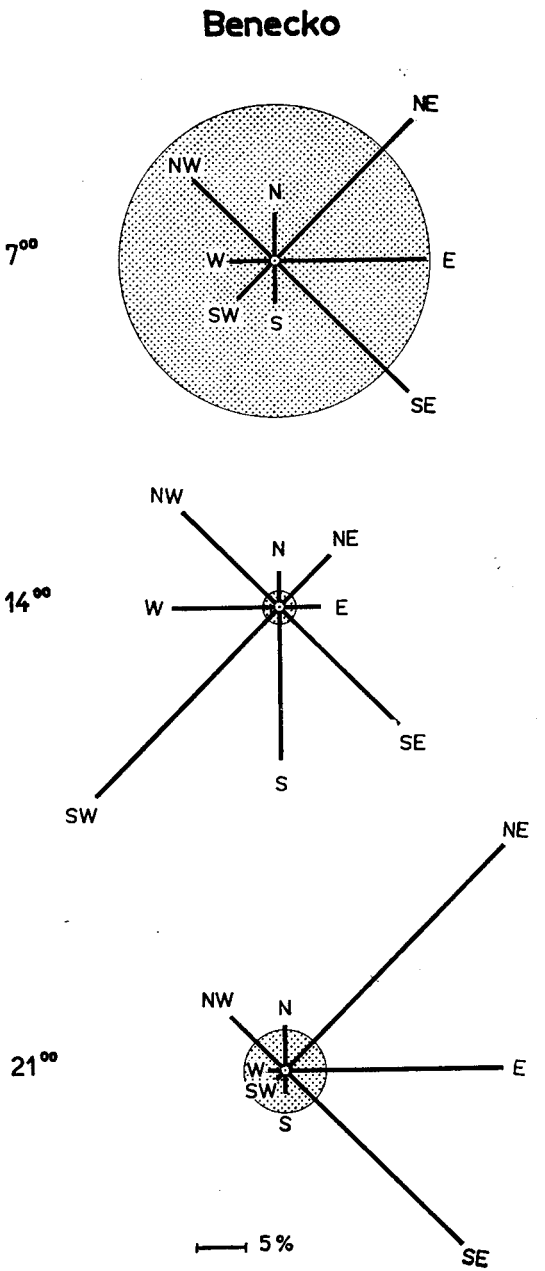


Fig. 6. Air currents in Jizerka valley in days with anticyclonal weather situations (May — September)

In order to determine how these theoretical assumptions are reflected in the Krkonoše Mts,, we picked out all days with anticyclonal weather situations for two valley stations, Harrachov and Benecko, in May through to September and processed the observations of the wind direction separately according to individual dates (see Tab. 3, Figs 5 and 6). It was found that the theoretical assumptions mentioned could also be applied to the wind conditions in the

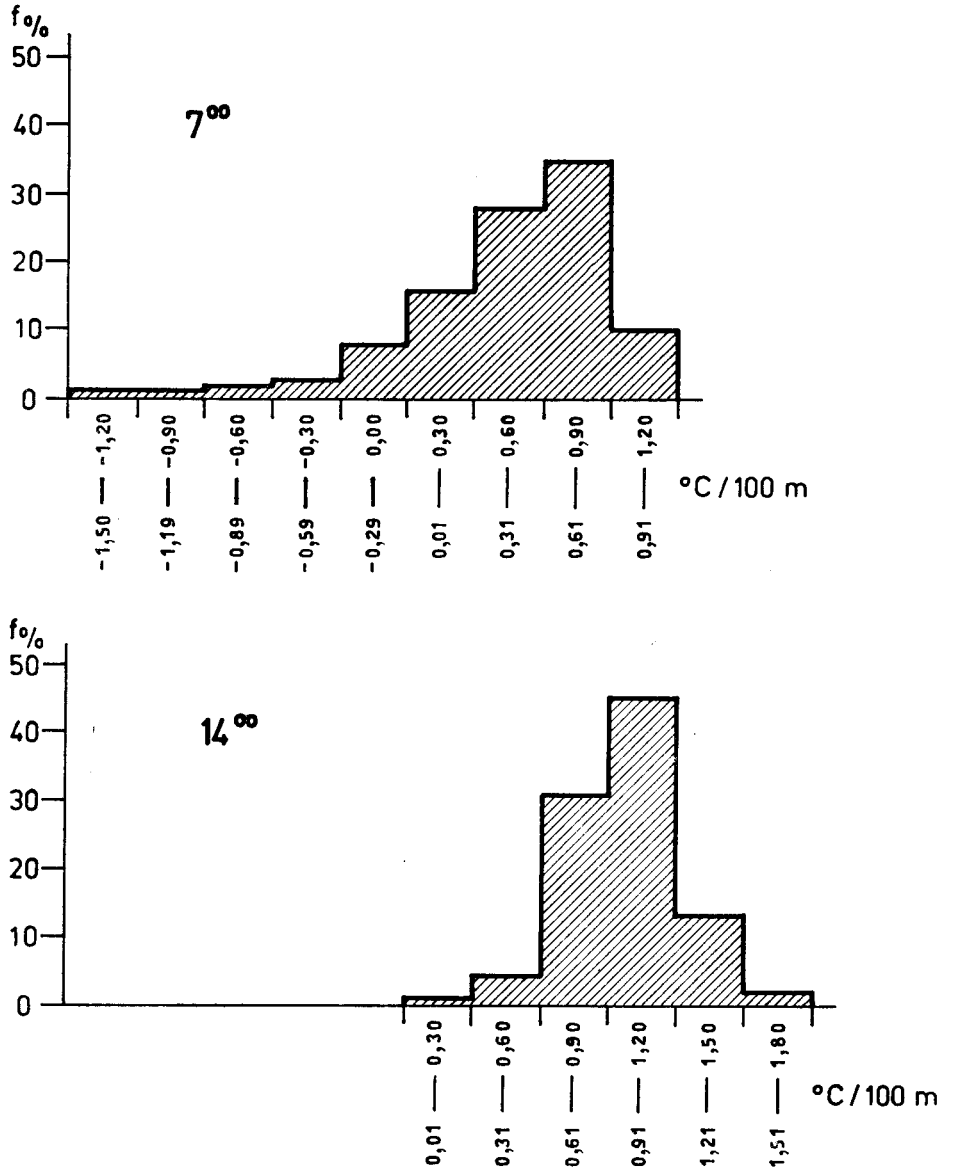


Fig. 7. Air temperature gradient

Krkonoše valleys. At the same time, one must bear in the mind that the investigated set is not ideal, because even during anticyclonal situations, in the concept of the authors of the catalogue, cases occur with predominant flow in the large-scale sence, i.e., in valleys the wind system is generated by the superposition of these components, or local dynamic effect is suppressed.

At both stations several identical features were observed in the daily variation of the wind direction. The considerable number of calm periods in the morning time of observations, which exceeds 15 % of all cases, is very typical. The calms are conditioned dynamically. When the air flows into the valleys at night, very frequently isothermia is formed, which changes to inversion. The air in the valleys becomes stably stratified during the night (its stability is maximum probably after sunrise). Although the first vertical motions occur in this layer immediately afterwards, the non-adiabatic gradient is preserved, as can be seen, for a certain length of time. The stabilized ground air layer is typically displayed by calm.

Using the pair of stations Vítkovice, Vrbatova chata — Harrachov as an example, we investigated the frequencies of various air temperature gradients at 7 and 14 hrs for the set mentioned above (see Fig. 7). It was found that in the morning the gradient was smaller than 0.3 °C/100 m in more than 25 % of the cases, and gradients over 1.2 °C/100 m did not occur. In the early hours of the forenoon the conditions differ appreciably; gradients of less than 0.3 °C/100 m did not occur.

Besides, in the morning interval the winds blowing down into the valley are still relatively frequent (in Harrachov an easterly wind, in Benecko a northwesterly). In the afternoon interval the frequency of winds blowing up the slope in Benecko (south, south-east) and up the valley (south-east) is increased, but in Harrachov only the frequency of the winds blowing along the slopes is increased, whereas the frequency of the westerly flow does not increase at all. Both stations display a typically small number of calm periods.

Finally, in the late evening an increased frequency of winds blowing down the slope (north-east, east) is typical for Benecko, and winds blowing down the valley (east) for Harrachov. The number of calm periods, as compared with the afternoon, did not increase appreciably, and the air in the valleys is not stabilized yet.

Apart from these similar features, other elements were found in our data, which did not agree with the theoretical assumptions. In Benecko this concerns the large frequency of winds with an easterly component in the morning and a considerable frequency of south-easterly winds in the evening; in Harrachov a large frequency of easterly winds in the afternoon. We are not able to explain this at present; we think that this is due to the more complicated configuration of the real terrain as opposed to the simplified model.

4. FLOW IN FOG

Since fog on the peaks and ridges and in the foothills is incommensurable genetically, we considered it expedient to deal with flow in fog in detail. The practical consequence of this is that during fogs at lower levels there is calm or only little flow, on the mountain ridges, however, a storm can be in progress inspite of the fog. This is due to the fog on the mountain peaks being frequently

a cloud or trontal cloudiness, whether of warm character (Ns, Fs, St), or of the cold front type (Cu, Cb).

In this connection the sudden changes in the weather conditions along the peak regions ranges are known, which have not infrequently led to the loss of life and frequent formation of intense icing.

Table 4 — **The wind regime during the fog**
Tab. 4 — **Proudění při mlze**
Таб. 4 — **Ветер при тумане**

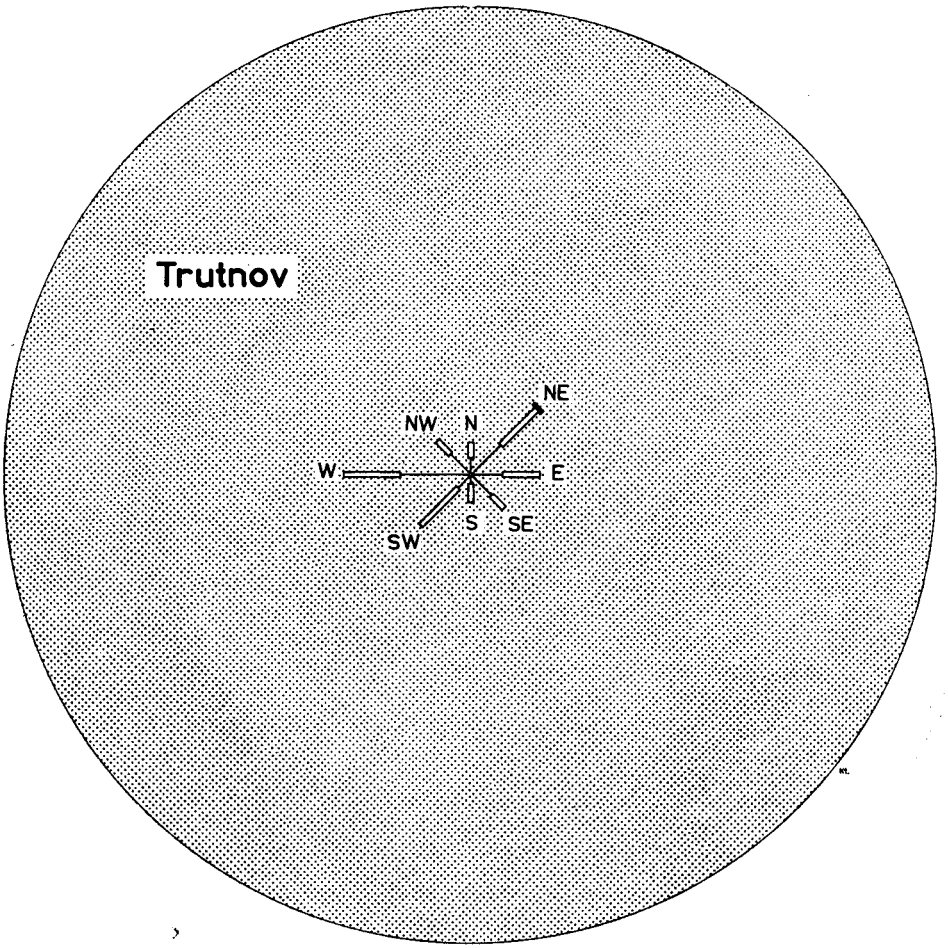
wind speed m/sec rychlost větru m/s скорость ветра м/сек	N	NE	E	SE	S	SW	W	NW	calm	Σ
	Vítkovice, Vrbatova chata									
1	0,16	0,40	0,16	0,44	0,59	1,19	0,87	0,24		4,05
2—8	6,41	6,89	1,58	0,99	5,46	19,17	15,24	8,47		64,21
≧9	4,59	5,58	0,95	0,08	1,46	8,31	4,87	3,21		29,05
Σ	11,16	12,87	2,69	1,51	7,51	28,67	20,98	11,92	2,14	—
	Trutnov									
1	1,61	4,18	3,21	2,89	0,96	1,93	7,07	2,89		24,74
2—8	1,61	5,14	3,86	1,93	1,93	5,47	5,79	1,93		27,66
≧9	.	0,32	.	.	.	.	.	.		0,32
Σ	3,22	9,64	7,07	4,82	2,89	7,40	12,86	4,82	47,27	—

For this reason we recorded the direction and speed of the wind at the stations of Vítkovice, Vrbatova chata on the ridge and Trutnov in the foothills, during the observational sequences in which fog occurred. The results are represented in Tab. 4 and in Fig. 8. It was found that in the foothills fog is a typical feature of calm situations. Calm occurs in nearly 50 % of the casses; otherwise the wind rose is similar to the average or the whole period. With a few exceptions wind of higher speeds did not occur.

On the other hand, the conditions on the ridges are quite different. Even here the wind rose is similar to the average, however, the number of calm periods is smaller; the frequency of winds with speeds of 9 m/s and over is larger. This fact is more evident in favour of the fog at higher levels being cloudiness with its base below the altitude of the station, and very frequently frontal cloudiness.

5. CONCLUSION

The classical treatment of the wind conditions in the Krkonoše Mts. and some of the specific features contribute in a modest way to the cognizance of the local climate by an element which has hitherto not been treated in detail for Bohemia and Moravia because of the difference of the terrain. And this was the purpose of the article. It is to the detriment of the purpose that the treatment could not have bean based on the observations and measurements of se-



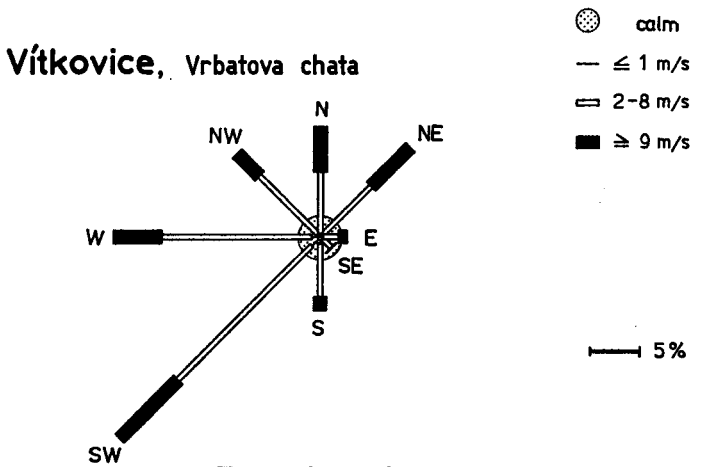


Fig. 8. Flow in fog

veral professional stations, equipped with standard instruments. However, it should be pointed out that most of the voluntary observers work reliably, so that it is possible to interpret the results in a suitable manner.

REFERENCES

Brádka J. (1968): Katalog povětrnostních situací na území ČSSR. Meteorologické zprávy, 21, No. 5, pp. 159—160.

Brádka J. (1969): Neobvyklé rozložení srážek na území ČSSR dne 16. XI. 1968. Meteorologické zprávy, 22, No. 5, pp. 128—130.

Defant Fr. (1951): Local winds. In: Compendium of Meteorology. Boston.

(1967): Katalog povětrnostních situací pro území ČSSR. Praha.

Šebek O., Coufal L. (1969): Klimatické poměry Krkonoš. In: Příroda Krkonošského národního parku. Praha.

Obr. 1. Větrná růžice hřebenové stanice
Obr. 2. Větrné růžice údolních stanic
Obr. 3. Větrné růžice stanic v podhůří
Obr. 4. Schematické vyobrazení denních změn větru v údolí (podle Defanta)
(a) východ slunce (b) dopoledne (c) poledne a časné odpoledne (d) pozdní odpoledne (e) večer (f) časná noc (g) půlnoc (h) pozdní noc
Obr. 5. Proudění v údolí Mumlavy ve dnech s anticyklonální povětrnostní situací (květen—září)
Obr. 6. Proudění v údolí Jizerky ve dnech s anticykolnální povětrnostní situací (květen—září)
Obr. 7. Teplotní gradient
Obr. 8. Proudění při mlze

Рис. 1. Роза ветра для гребенной станции
Рис. 2. Розы ветра для долиных станций
Рис. 3. Розы ветра для станций в подгорной местности
Рис. 4. Схематическое изображение суточных изменений ветра в долинах (по Дефанту) (a) восход (b) время до полудня (c) полдень и рано пополудни (d) поздне по полудни (e) вечером (f) рано ночью (g) полночь (h) поздне ночю
Рис. 5. Ветер в долине Мумлавы в днях с антицилконическим положением погоды (май—сентябрь)
Рис. 6. Ветер в долине Изерки в днях а антициклоническим положением погоды (май—сентябрь)
Рис. 7. Градиент температуры
Рис. 8. Ветер при тумане