

TEMPORAL AND SPATIAL CHANGES OF CLIMATE ELEMENTS IN HUNGARY

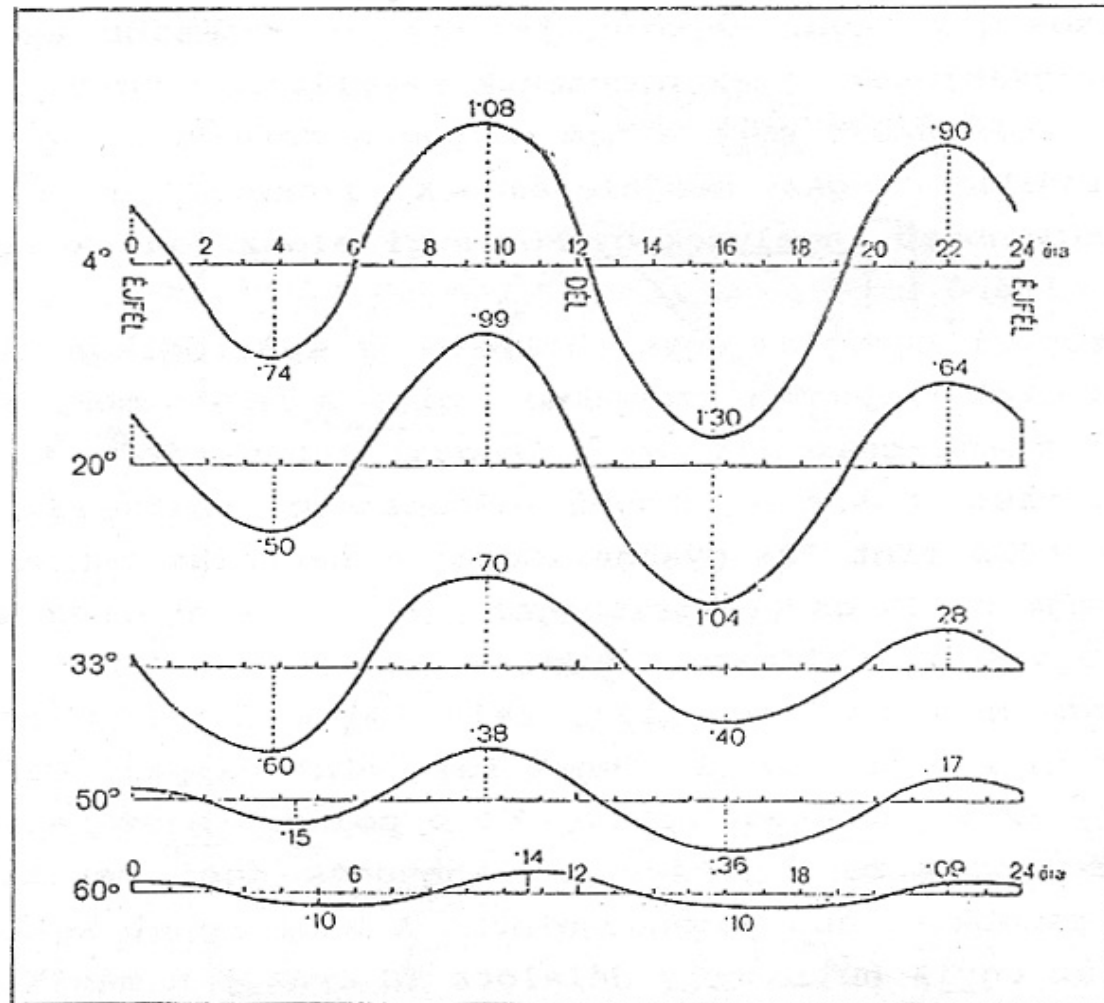
AIR PRESSURE AND WIND



Air pressure

- ◆ Different warming of the Earth's surface generates air pressure differences in the atmosphere above the surface. In order to compensate air-pressure differences, air particles move from high-pressure areas to low-pressure areas. a levegőrészecskék elmozdulnak a magas nyomású területek irányából az alacsony nyomású területek felé. This horizontal airflow is called wind.
- ◆ Therefore, air pressure has direct and indirect association with several climatic elements. This is one of the most basic climatic elements.
- ◆ As a result, in the early 20th century, a wide range of meteorological phenomena were tried to explain on air pressure basis. Later, this approach was pushed into the background.
- ◆ One element of preparing recent large-scale weather forecasts is analysis of air pressure - topographic maps.
- ◆ Because of its physiological effects (human biometeorology) it is also important.

Temporal dynamics of air pressure



Daily course of air pressure between the Equator and the 60°N latitude

- ◆ Air pressure is the most stable climatic element. Its daily and annual fluctuations are only up to some %.
- ◆ Its daily course show a double wave: the main maximum is around 10-11 am; while the main minimum is around 4-5 óra pm; secondary maximum is around 10-11 am; secondary minimum is around 4-5 am.
- ◆ The amplitude of the daily pendulum decreases from the Equator to the poles. The regular daily pendulum in Hungary is generally 1-6 mb, while passing through of a weather front may cause even a pendulum of 10-20 mb.
- ◆ Its annual course also shows a double wave.
- ◆ Main minimum: April-May (midlatitude cyclones coming from the direction of the Icelandic minimum).
- ◆ Main maximum: January (anticyclones breaking into the Carpathian basin from the direction of the Siberian maximum).
- ◆ Secondary minimum: July (due to the strong warming of the central part of the basin).
- ◆ Secondary maximum: September-October (anticyclones breaking into the Carpathian basin from the direction of the Azorean maximum).

Annual course of air pressure, Debrecen, 1928-1978;
900+...hPa, or 1000+...hPa

Jellemző	J.	F.	M.	Á.	M.	J.	J.	A.	Sz.	O.	N.	D.	Év
Átlag	99,9	97,4	97,4	95,0	95,8	95,6	95,6	96,4	98,8	98,8	99,5	99,4	98,0
Max.	113,8	113,5	106,1	102,0	100,1	99,8	100,3	101,2	104,8	107,5	110,5	113,9	100,0
Min.	90,7	88,6	88,9	89,8	89,7	91,5	91,5	92,2	94,6	92,2	93,0	90,9	94,7
Íngás	23,1	24,9	17,2	12,2	9,6	10,1	8,8	9,0	10,2	15,3	17,5	23,0	5,3

Annual course of air pressure, 1901-1950, hPa

Állomás	J.	F.	M.	Á.	M.	J.	J.	A.	Sz.	O.	N.	D.	Év
Budapest	1001,6	999,6	975,2	995,5	996,6	996,8	996,6	997,4	1000,0	999,9	999,9	1000,2	975,9
Kékestető	898,7	897,0	896,5	896,4	900,1	900,9	901,3	902,1	903,2	901,7	899,5	897,9	899,6

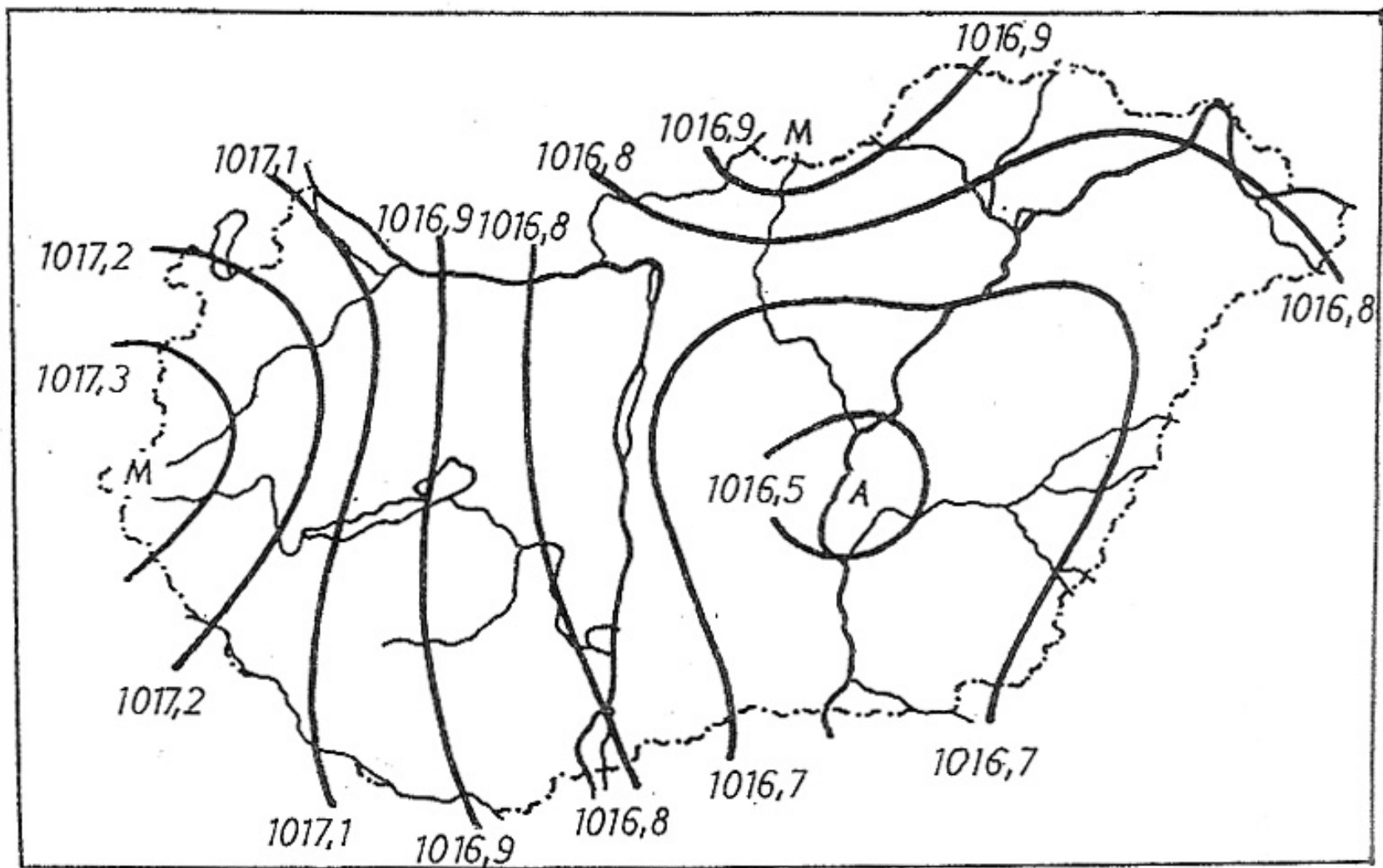
Budapest – 129,6m, Kékestető – 990,5m

- ◆ The pendulum of mean monthly air pressure is between 9.0 and 25.0 mb.
- ◆ In winter, the pendulum is higher (23.0-25.0 mb) due to the frequent anticyclonic large-scale weather situations, while in summer it is smaller (9.0-10.0 mb) due to the higher frequency of the cyclonic large-scale weather situations. The absolute pendulum is 70-80 mb.
- ◆ In the mountainous areas air pressure decreases with height, with an average of 10-12 mb / 100 m.
- ◆ The decrease in air pressure is higher in cold air in winter, while it is smaller in warm air in summer.

Vertical gradient of air pressure, hPa / 100 m

	J.	F.	M.	Á.	M.	J.	J.	A.	Sz.	O.	N.	D.	Év
1.	12,4	12,3	12,1	11,8	11,4	11,3	11,3	11,3	11,6	11,8	12,1	12,3	11,8
2.	11,2	11,0	11,0	10,9	10,8	10,5	10,5	10,6	10,6	11,0	11,0	11,3	10,9

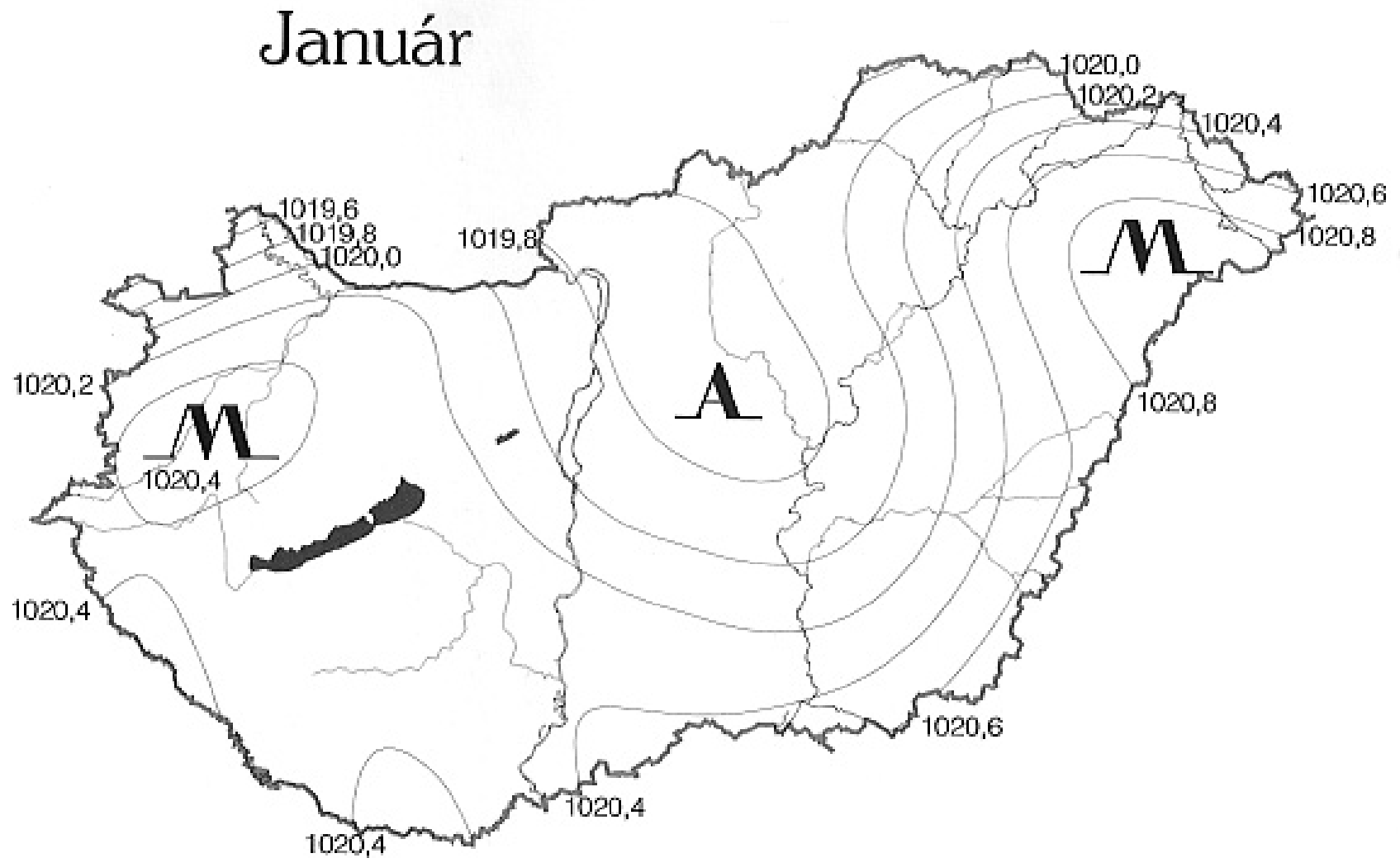
1. Between Budapest Szabadság-hegy and Budapest Meteorological Institute;
2. Between Kékestető and Mátraháza (30-year mean);



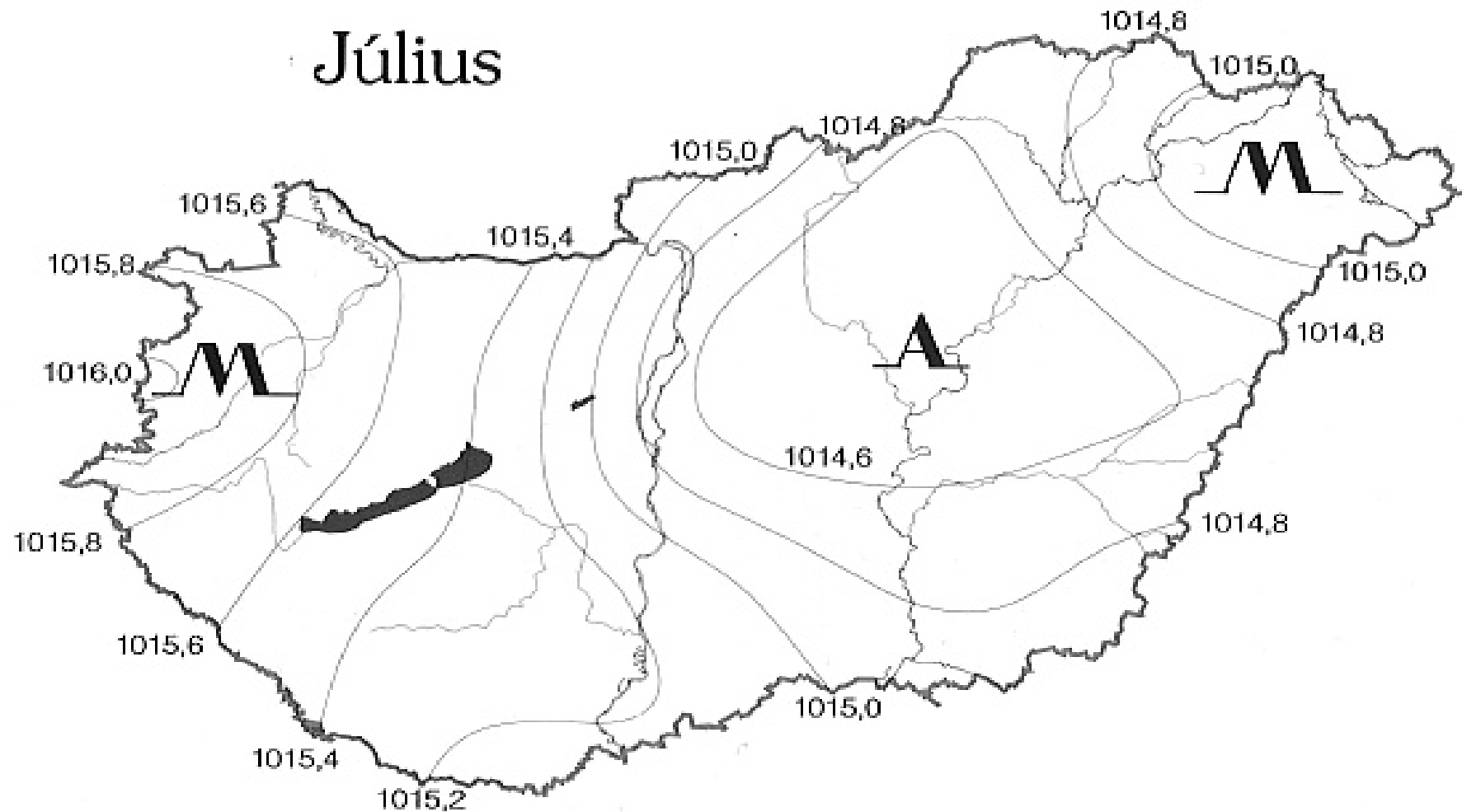
Areal distribution of mean annual sea level air pressure in Hungary, hPa

- ◆ According to the map of areal differences of sea level air pressure, relatively low mean sea level air pressure occurs at the central part of Hungary; furthermore, sea level air pressure is relatively low both in January and July.
- ◆ Towards the edge areas, i.e. towards west, north and north-east the air pressure increases.
- ◆ The low pressure area at the central part of Hungary is due to the basin-effect: over the strongly warming central part the air pressure is smaller.
- ◆ Foehn wind coming from the Alps in the west and from the Carpathians in the east cause an increase in air pressure at the edge areas.
- ◆ Areal differences are of thousandth magnitude: in an annual average the difference is 0.8 mb; in winter it is 0.4 mb; while in summer 1.4 mb.

Mean sea level air pressure in Hungary, January, hPa



Mean sea level air pressure in Hungary, July, hPa

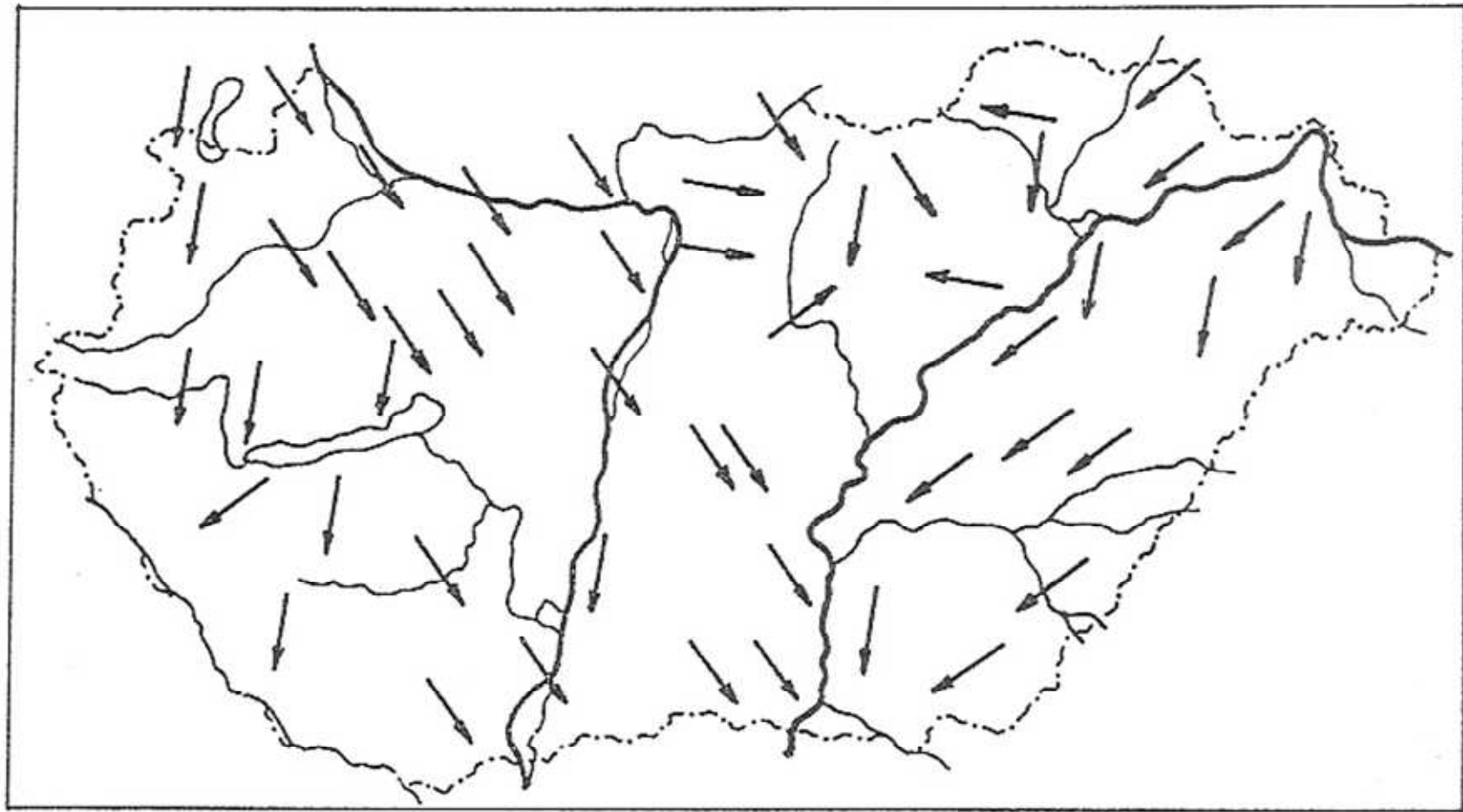


Wind

- ◆ Wind, similarly to solar radiation, is a meteorological element of basic importance, because it influences almost all meteorological elements.
- ◆ Wind is a vector, it can be characterized by its strength (wind speed - m/s) and direction (where from it blows – orientation, degree, or a direction scale of 32).
- ◆ Due to the meridional heat exchange, wind directions are not so stable in the temperate belt compared to the tropics or the polar areas.
- ◆ While in the temperate belt the relative frequency of the prevailing wind is 70-80%, in the Carpathian basin this ratio is a mere 15-35%.

Relative frequency of different wind directions
in Hungary, %, 1901-1950

Station	É	ÉK	K	DK	D	DNY	NY	ÉNY	Calm
M. magyaróvár	7	4	4	18	9	6	7	35	10
Szombathely	27	9	2	2	8	19	7	7	19
Zalaegerszeg	23	7	2	8	18	9	2	6	25
Budapest	10	8	5	8	7	6	10	26	20
Kecskemét	10	14	7	10	9	11	14	14	13
Szeged	16	8	6	11	16	10	11	17	5
Békéscsaba	15	17	5	10	12	14	8	13	6
Debrecen	10	17	10	10	15	18	7	4	11
Nyíregyháza	12	25	3	7	6	22	4	8	13



Prevailing wind directions in Hungary

◆ Regarding the prevailing wind directions, 4 characteristic regions can be distinguished in Hungary:

1. Northwesterlies: in Kisalföld, the large part of Dunántúli Medium-high Mountains and between Danube and Tisza Rivers.

This is the wind inflow direction through the "gate" at Dévény, which is not altered by the Dunántúli Central Mountains of southwest-northeast direction strikes.

2. In the area of the Alps and Zala Hills northern winds are characteristic. They develop by spreading out of the main north-western flow that enter the "wind gate" at Dévény.

In the area of Zala Hills, the meridional valley network further strengthens the near-surface northern winds.

3. In the area of the Northern Medium-high Mountains there are no any prevailing wind direction. In the area of Börzsöny and Cserhát Mountains western winds, in Mátra Mountain northern winds, in Bükk Mountain north-western winds, in the Aggteleki karst eastern winds K-i, while in the Zempléni Mountain north-eastern winds are characteristic.

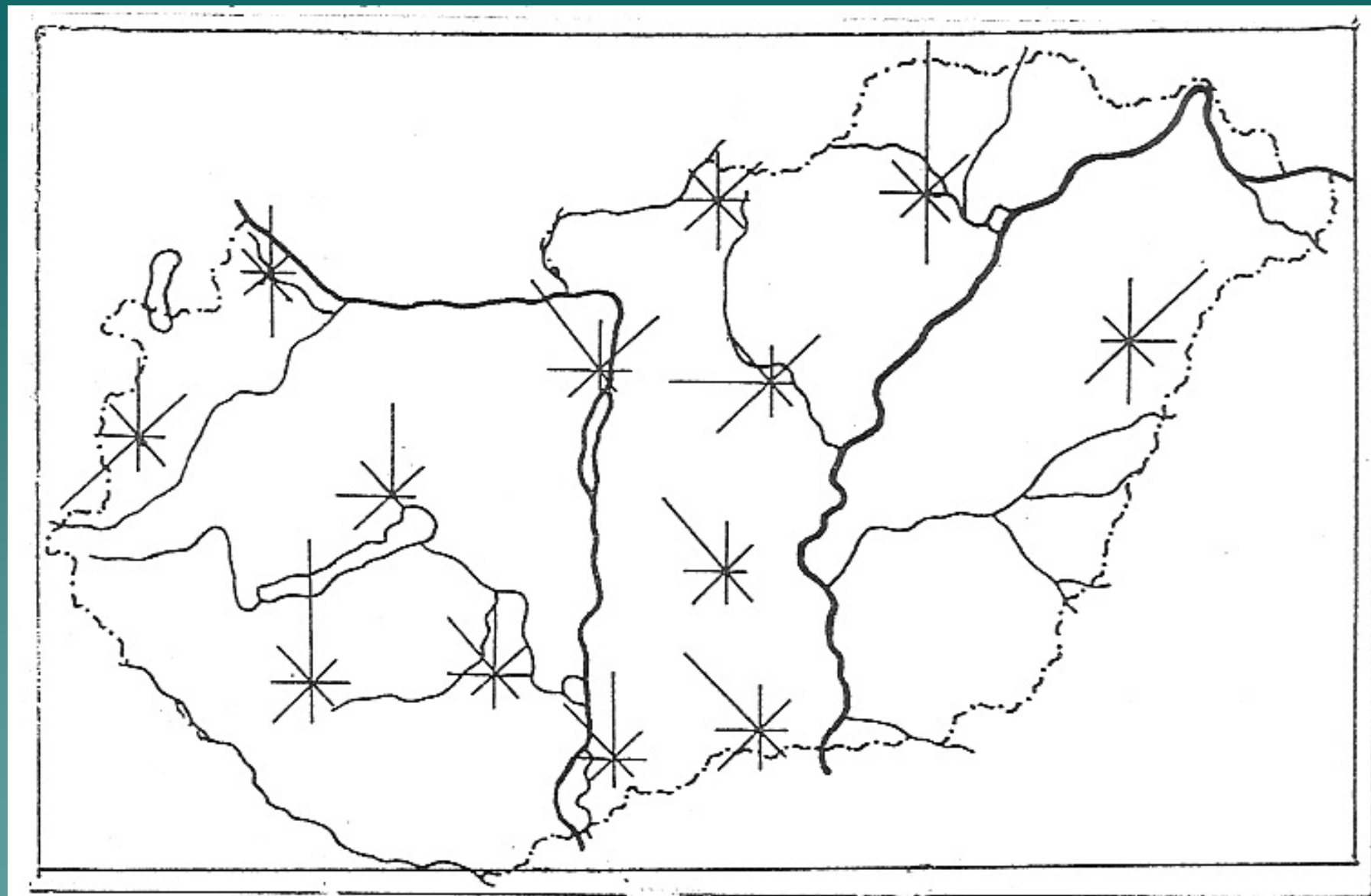
At the same time, in Mátraalja south-western, and in Bükkalja south-eastern winds are the most frequent.

Along river valleys (Zagyva, Hernád) northern winds are most common.

4. In Tiszántúl northeastern winds prevail, together with south-western winds.

Its reason is the Tiszántúli wind channel. Continental air masses crossing the ridge of around 1000 m height of NE-Carpathians get into the wind channel between the Zempléni Mountain and Apuseni Mountains.

- ◆ Relative frequency of wind directions used to be presented by wind direction diagrams. From these not only the prevailing wind directions but also the frequency of wind directions can be displayed.




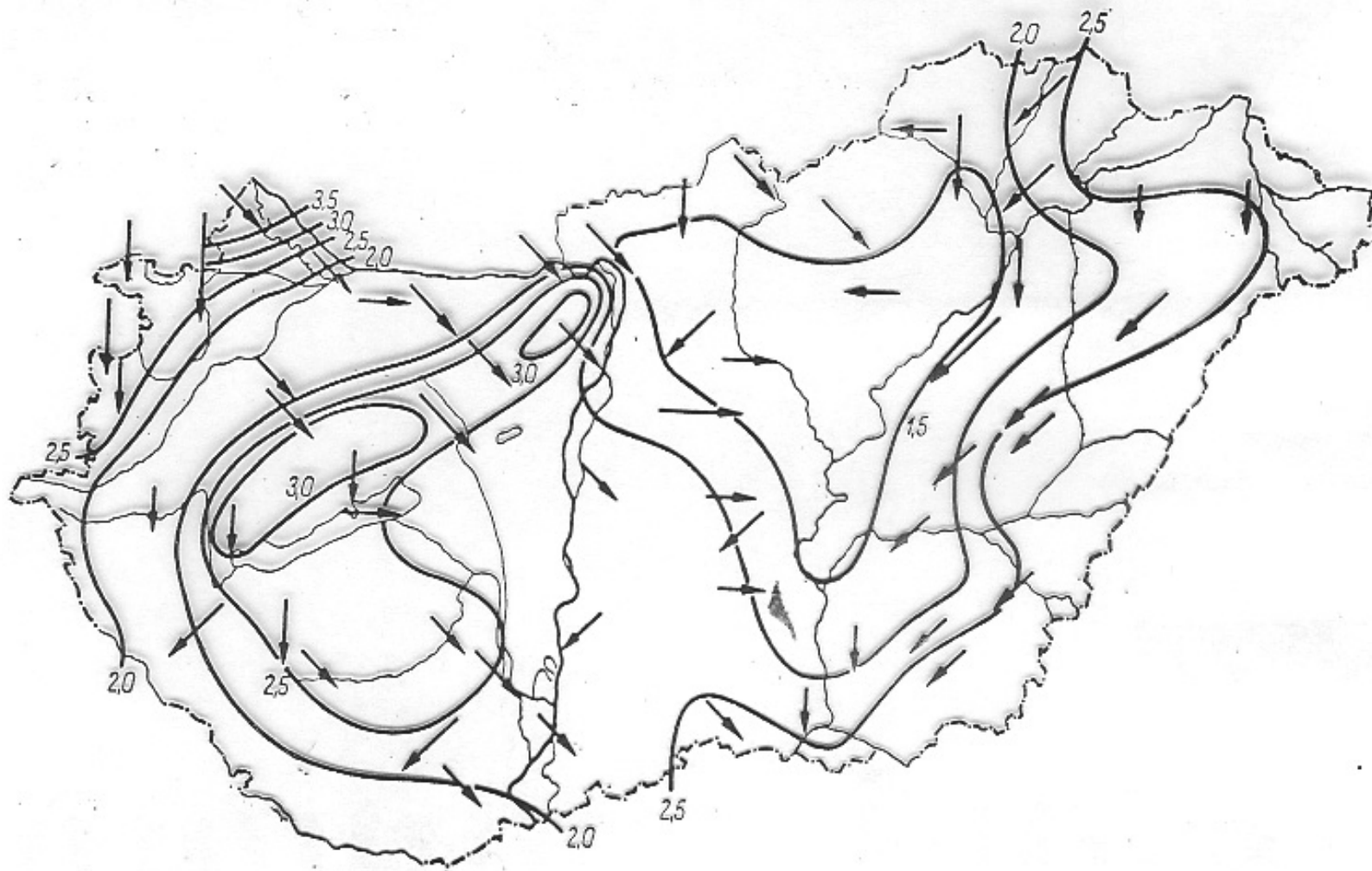
Mean annual wind roses in Hungary

- ◆ As it can be seen from the table below, well over the friction layer, at 5 km height above surface, where the wind direction changing effect of the relief is no longer present, the picture is much more uniform.
- ◆ In 59% of the cases wind blows from west, which corresponds to the typical basic westerlies in the temperate belt.

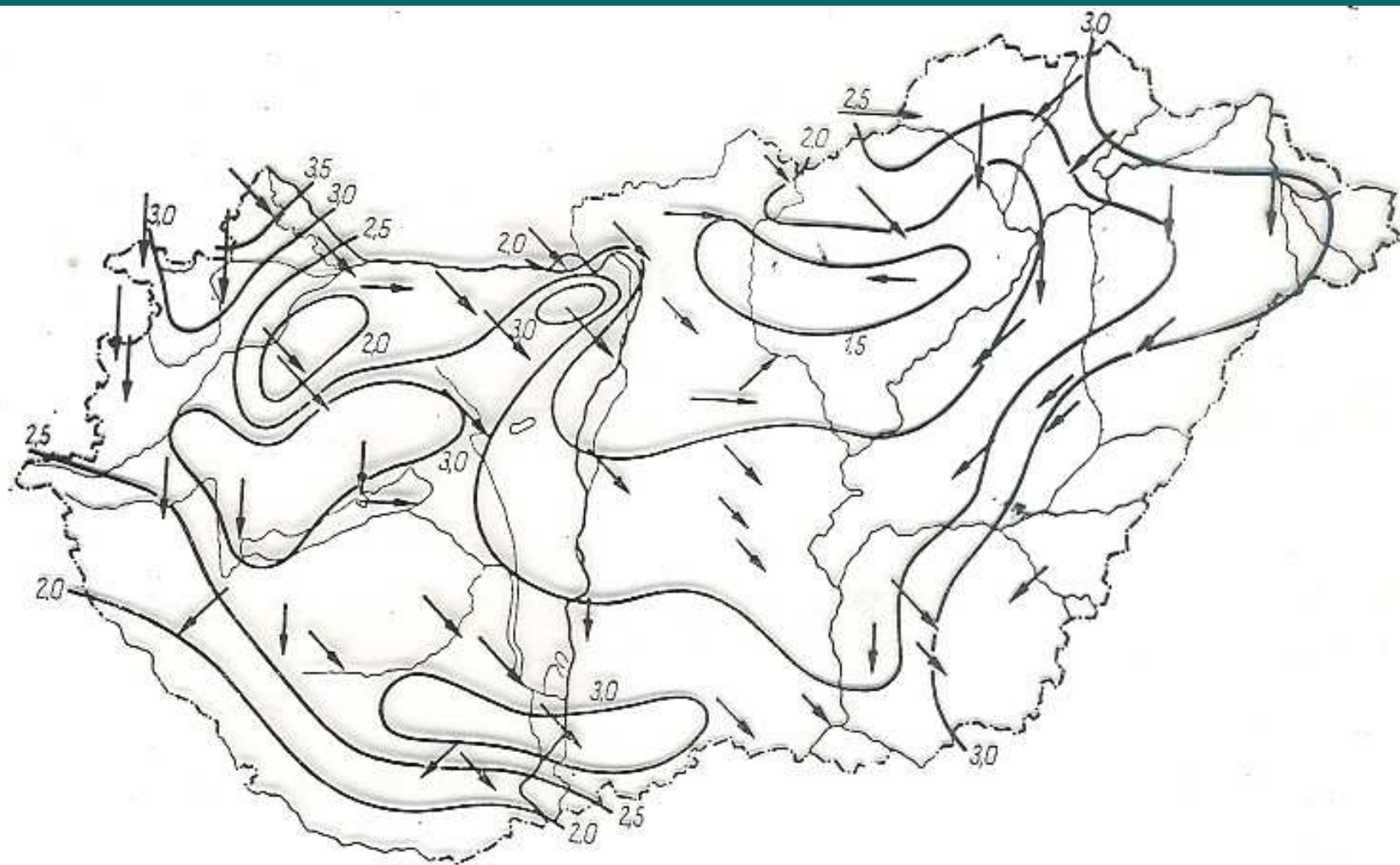
Relative frequency of wind directions (%)
at 5 km height above surface in Hungary

N	NE	E	SE	S	SW	W	NW
16	9	6	4	6	14	23	22

- ◆ Another important characteristic of wind is speed. Its value is highly influenced by the basin location of Hungary: mean annual wind speed (at 10 m height) is between 2-4 m/s.
 - ◆ Regarding Europe, this wind speed counts low. The Carpathian basin can be considered protected from wind.
 - ◆ Especially strong wind protection is characteristic in the SE foreground of the medium-high mountains.
 - ◆ Wind speed over Hungary is featured by spring (March, April) maximum and autumn (September) minimum.
 - ◆ Daily course of wind speed can be described by early afternoon maximum and early morning minimum.
 - ◆ The consequence of the topography and basin character is that invasion of different air masses into the basin is delayed, at the same time anticyclonic large-scale weather situations persist.
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Prevailing wind direction and mean wind speed in Hungary, summer half-year, m/s, several-year means (after Kakas)



Prevailing wind direction and mean wind speed in Hungary, winter half-year, m/s, several-year means (after Kakas)



Always look on the bright side
of things!

We finished for today, goodbye!

ямарваа нэг зүйлийн гэгээлэг
талыг нь үргэлж олж харцгаая
өнөөдөртөө ингээд дуусгацгаая, баяртай

让我们总是从光明的一面来看待事物吧！

今天的课程到此结束，谢谢！

دعونا ننظر دائما إلى الجانب المشرق
الأشياء! من

انتهينا لهذا اليوم، وداعا!