DIGITAL APPROACH TO ESTIMATING MONTHLY AND YEARLY CLIMATOLOGIC WIND DATA

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Abstract

Wind is a meteorological element with changeable spatial and temporal appearance, which occurrence and variation is crucially initiated by pressure gradients, as strongly affected by solar radiation, global and local atmospheric circulations, relief, etc.
With a purpose to optimally plan an established use of various types of constructions, one would essentially require wind speed and wind direction estimates. Wind assessment is particularly important when planning and performing activities related to localizing (forest) fires; it affects the biosphere in both physical and biological manner. Moreover, the global concern arising from environmental pollution and climate change has strongly emphasized the development and use of renewable sources of energy, amongst which wind is one with a huge potential.

Apart from those listed above, wind assessments are important for large number of other applications and informative goals. Therefore, it is crucial that wind data for a given region of interest is adequately processed and the final product is quickly received in a comprehensive format. Considering the large amount of data regularly received from an automatic and/or conventional measuring system, a digital application for simplifying the incoming data quick and easy is required.

The paper describes an application for processing, assessing and presenting wind data in a comprehensive, fast and sophisticated manner, unlike the conventional manual methods that were used in UHMR thus far. The application has been developed using Lotus and Microsoft Excel. With the aid of a few examples, the precision, potential use and importance of adequate wind assessment will be demonstrated.

Key words :*Wind,wind assessment,applicatia KLIINFOw, digital data processing*

Veterot e meteorolo{ki element so promenliva prostorna i vremenska raspredelba ~ie pojavuvawe i varirawe voglavno e predizvikano od promenlivosta na pritisokot pod vlijanie na son~evoto zra~ewe, globalnata i lokalnata atmosferka cirkulacija, reqefot i t.n. So cel za optimalno planirawe, koristewe pri razli~ni tipovi na gradbi, potrebno e presmetuvawe na brzinata i pravecot na veterot. Presmetuvaweto na veterot e osobeno va`no koga se planiraat i izveduvaat aktivnosti povrzani so lokalizirawe na po`ari. Veterot vlijae na biosferata od fizi~ki i biolo{ki aspekt. Globalnata zagri`enost se pove}e raste poradi zagaduvaweto na okolinata i klimatskite promeni koi silno vlijaat na razvojot i koristeweto na obnovlivite izvori na energija, me|u koi izvori, veterot e eden od izvorite so pogolem potencijal.

Pokraj ova pogore, procenkata za veterot e va`na za golem broj drugi primeni i informativni celi. Odovde, va`no e deka podatocite za veterot za daden region se adekvatno presmetani i finalniot produkt se dobiva brzo vo soodveten format. Zemaj}i go vo predvid golemiot broj na regularni podatoci od avtomatskite i/ili konvencionalniot meren sistem, potrebna e brza i lesna digitalna aplikacija za poednostavuvawe na upotrebata na podatocite.

Vo temava se zboruva za aplikacija za procesirawe, presmetuvawe i prezentirawe na podatoci za veterot na soodveten, brz i sofisticiran na~in, razli~en od konvencionalnite manuelni metodi {to bea koristeni vo UHMR, pred kompjuterskata tehnologija. Aplikacijata e razviena so koristewe na 123Lotus i Microsoft Excel. Prilo`eni se nekolku primeri, od koi se gleda preciznost, a prika`an e i potencijal na koristewe so adekvatni izve{tai za veterot koi se voedno i prezentirani.

Preface

Meteorology with the new technology becomes more exact science, science which goes ahead with a great steps opening new possibilities.

World famous and powerful companies do prepare comprehensive analyse and forecasts for different needs with certain meteorological elements.

They are provider on services, which are used for getting expensive business decisions connected with the weather and climate.

Public media, health care organizations, surface transport, aviation, civil engineering, sport, electric power management, more then 22.000 organizations depend on such services.

They work on a new and better-organized way with local media and organizations with a purpose to optimally managed protection from bad weather conditions.

Because of the wide, with world dimension, protection on the human environment, danger exists from the unprofessional and not domestic acting with financial sums divided for this purposes. Thus, money will be spent with not positive results. Nature makes big expense to people because of these mistakes. We are all witness on huge and not overcome power of the nature. According this, one would say national Hydrometeorological services and WMO are here and they should be more careful with this problem. Global think, that the climate doesn't recognize borders, exist.

Organising and managing

UHMR,the national Hydrometeorological service of R.Makedonia joined the WMO in 1993, which resulted in an increased involvement of the institute in various international activities. There are a few programs through which national Hydrometeorological services gives their contribution on local and international level in the development of suitable climate explores.
Our incorporating in these programs through WMO-Regional associations and some other organised systems do come true.
One of these systems with the organized managing is GCOS. Established in 1993, the Global Climate Observing System (GCOS) is one of WMO's operational systems providing guidance, stimulation, and coordination to national institutes in the global climatological monitoring systems.
This includes complex numerical procedures aimed at processing and safely archiving of needed data.
Standard climatological data processing includes calculation of average values, extremes, deviations, frequency of occurrences etc. of various meteorological elements.
Use of such data can be applied for assessing the impacts of climate variability and change in various socio-economical aspects (transport, construction, energy systems, healthcare, recreation etc.)

Among the programs through which we corporate in the frame of the Region VI are: Royal Dutch Hydrometeorological institute: ECA/ECD regional baseline datasets for climate research purposes. DWD-Offenbah - GPCC, RA-VI-Bulletin e.t.c.
All questions which are connected with the weather and climate can be resolved by observation and measurement of the atmospherically condition. So, the meteorological network is place where the observers doing their measurements according the special programs and their records are written in certain reports.

What with the modern automated and old conventional way of monitoring

Meteorological monitoring in R. Makedonia is connected with the possibility for making long series of meteorological changeable and representing the nature change. Data are useful for getting comprehensive professional and scientific conclusions.
With the computer technology observer's job is reduced, the same data shouldn't be input in different reports. Calculation on the certain meteorological data is by numerical methods and procedures through the computers. On this way now we have almost complete monitoring of the meteorological situations. The automatic stations are reality and many data are useful. But the huge of data demand more work.

The change of meteorological elements is fast, sometimes less important and sometimes more important, so from this three characteristic points of view we should dropped one to get the real indication.
So we have a problem with data we have got from the automatic measured systems with the almost existed long historical series of data to compare, and for getting fast conclusions.
There is a need of some steps through which the new formatted data will be good prepared for the next application and analyse.
So the problem with the data we have in different formats should be solved in advance by some procedure.
Results we have got through KLIINFO application are with the great quality, having in mind that the new application and its products are already proved in practice. Besides that from the informatics view there is many things one can do with the application.

The new way (by automatic measurements) for getting series of meteorological data is different of conventional. For determinate meteorological elements should be observed the grades of mistake during measurement with the new automatic system comparing with the conventional. Some meteorological elements during measurement with automatic system show good results but some, like precipitation, show bad results.
Automatic system has advantages but also and some negative characteristic.
It's enough to say that they work on electric power and are exposed on different nature and not nature strikes.It is very clear that human factor is important during all process of measurements.

What with data

If around one meteorological station building "raised up every day" the nature surroundings do change. "The lake of warm air" or urban region as we know in meteorological language is formed.
The regime of temperature has changed and because of that real temperature data are not comparable with the historical temperature data.

This temperature increasing or decreasing should be taken in view during analyse of the trend of temperature. Like repercussion of the change of the gradient of temperature change of the gradient of wind has appeared, as much as to the other elements and parameters which are part of the complex climate system.

One can ask how could be applicative archived data. Data are processing to get assessment of the appearance of meteorological elements, to get fast rapports from which can be noticed important picks, trends, frequentation, and for global understanding of climate.

After getting fast reports should be possible doing fast decisions and conclusions, which are important for real proper acting.

Among these fast report is "wind rose" which is a diagram, statistical preview of frequency of the wind e.t.c.

In the next text, products of the KLIINFO application are exposed. On figure 1 and 2, tables are shown and the frequentation of the wind direction with appropriate speed in October 2007 can be viewed (data from Skopje Z.R.). This data are by anemograph (FUESS) and automatic station (SEBA) measurements. The Anemograph is exposed on the roof of the UHMR building (25m above the ground) and automatic wind sensor is near the UHMR building (10m above the ground). Data is from Climatologically term.

The new technology gives us possibility for easier statistical assessments on meteorological data.
Using the application, we get frequentation of the wind direction on two different levels and with different type of measurement, different instrument. We also have frequentation of the wind from regular (every hour) and not regular (Climatologically term) data.

Application gives us possibility for fast assessing (work time of some minutes) on almost 4500 data per 10min measured by automatic station, 93 data per climatologically term measured by anemograph, and 744 regular data per every hour by anemograph.

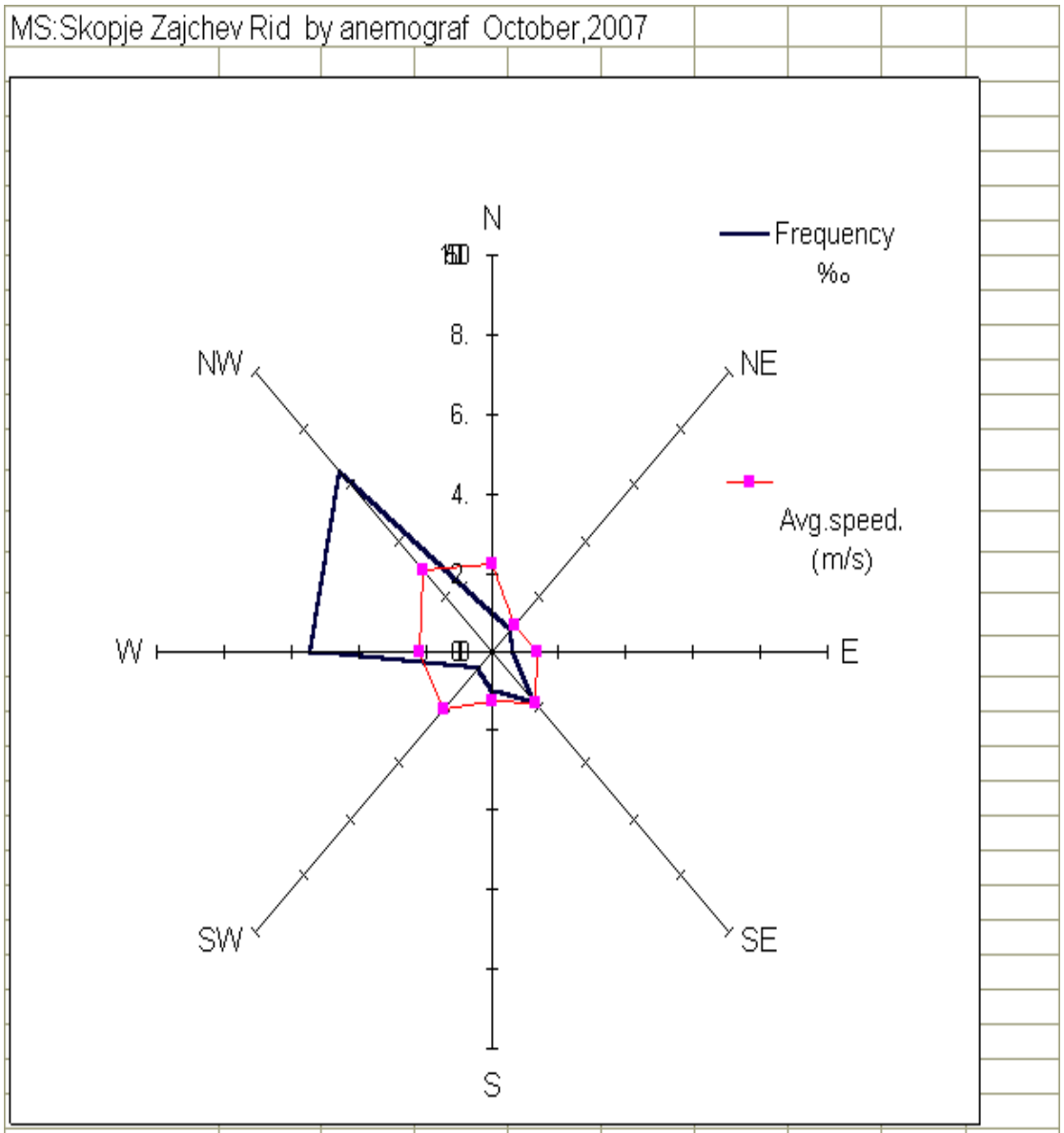
Figure 1 Frequency of the wind direction and wind speed by climatologically data, estimated with the application KLIINFO –w ; anemograph-FUESS, (25m above the ground)
October 2007-M.M.S. SkopjeZ.R.

	Freq.	sum speed	Freq.	sum speed	freq	sum speed	Freq.	sum speed	avg.speed
Calm	4	0.0	0	0	1	0	5	0.0	
N 32	2	3	1	5	2	3.0	5	11.0	2.2
NE 04	2	2	2	1.8	0	0	4	3.8	1.0
E 08	0	0.0	3	4.0	0	0.0	3	4.0	1.3
SE 12	1	0.5	7	15.7	1	0.7	9	16.9	1.9
S 16	0	0.0	4	5.4	1	0.7	5	6.1	1.2
SW 20	0	0.0	2	3.8	1	2.3	3	6.1	2.0
W 24	12	22.2	5	8.3	10	28.0	27	58.5	2.2
NW 28	10	23.0	7	24.2	15	46.5	32	93.7	2.9
							93		
Maximal term speed of the wind									
	8.0	m/sek							
	Day	Term	Direction						
	19	13.30	30						

Figure 2 Frequency of the wind direction and wind speed by climatologically data estimated with the application KLIINFO –w; automatic station SEBA, (10m above the ground)
October 2007-M.M.S. SkopjeZ.R.

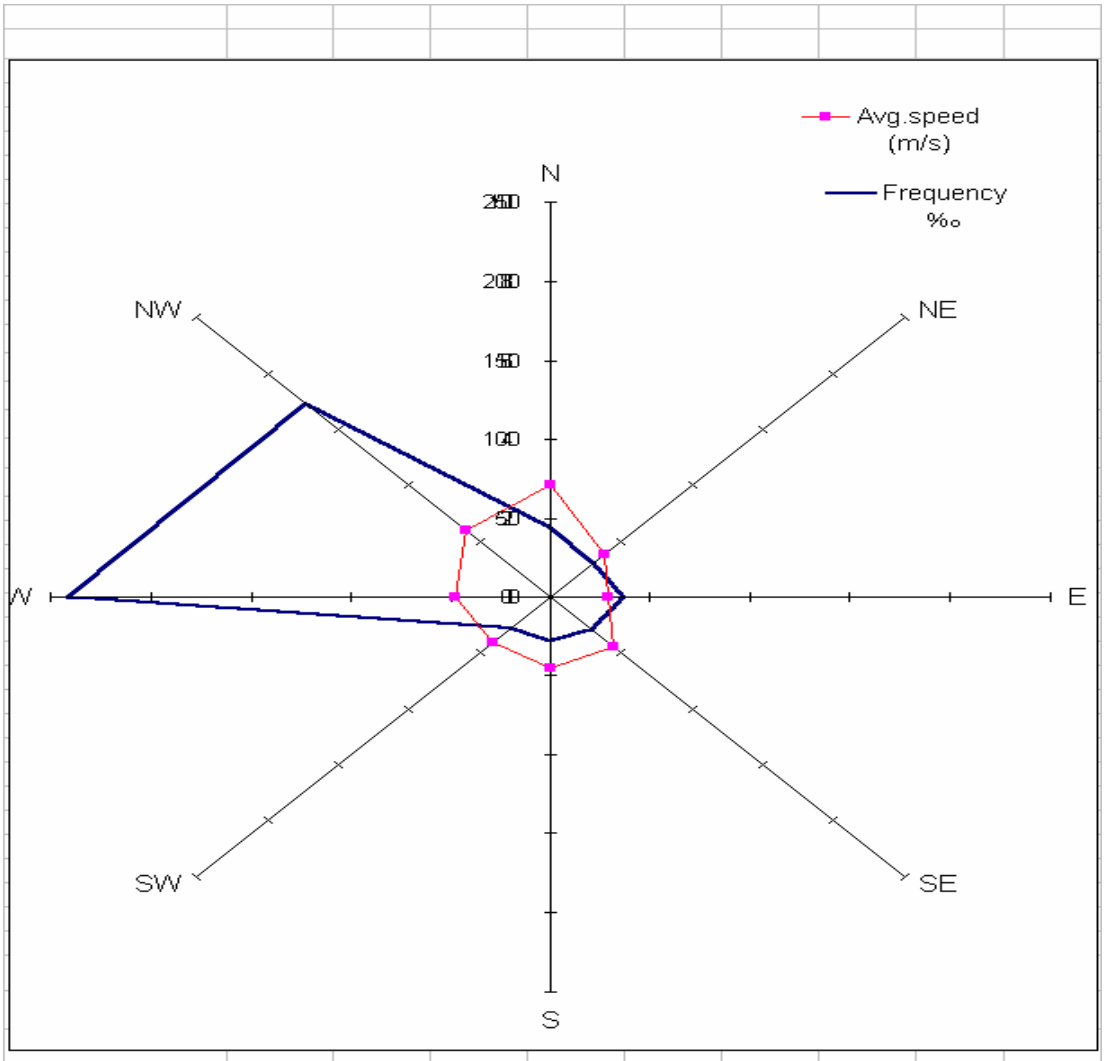
	Freq.	sum speed	Freq.	sum speed	Freq.	sum speed	Freq.	sum speed	avg.speed
Calm	15	0.3	4	0	4	0	23	0.0	
N 32	0	0	0	0	1	1.7	1	1.7	1.7
NE 04	0	0	2	3.3	0	0	2	3.3	1.6
E 08	2	3.2	6	13.3	3	5.4	11	21.9	2.0
SE 12	2	2.0	16	24.9	0	0	18	26.9	1.5
S 16	1	1.0	1	2.3	3	1.4	5	4.7	0.9
SW 20	3	1.2	2	2.0	3	1.6	8	4.7	0.6
W 24	5	4.0	0	0	13	13.5	18	17.4	1.0
NW 28	3	2.8	0	0	4	6.4	7	9.1	1.3
							93		
Maximal term speed of the wind									
	3.9	m/sek							
	Day	Term	Direction						
	14	13.30	10						

Figure 3 Monthly rose and wind speed in 8 directions, by climatologically data (25m above the ground); M.M.S. Skopje Z.R., October 2007 - anemograph



Direction	C(calm)	N	NE	E	SE	S	SW	W	NW
Frequency	5	5	4	3	9	5	3	27	32
Avg.speed m/sek		2.2	1.0	1.3	1.9	1.2	2.0	2.2	2.9

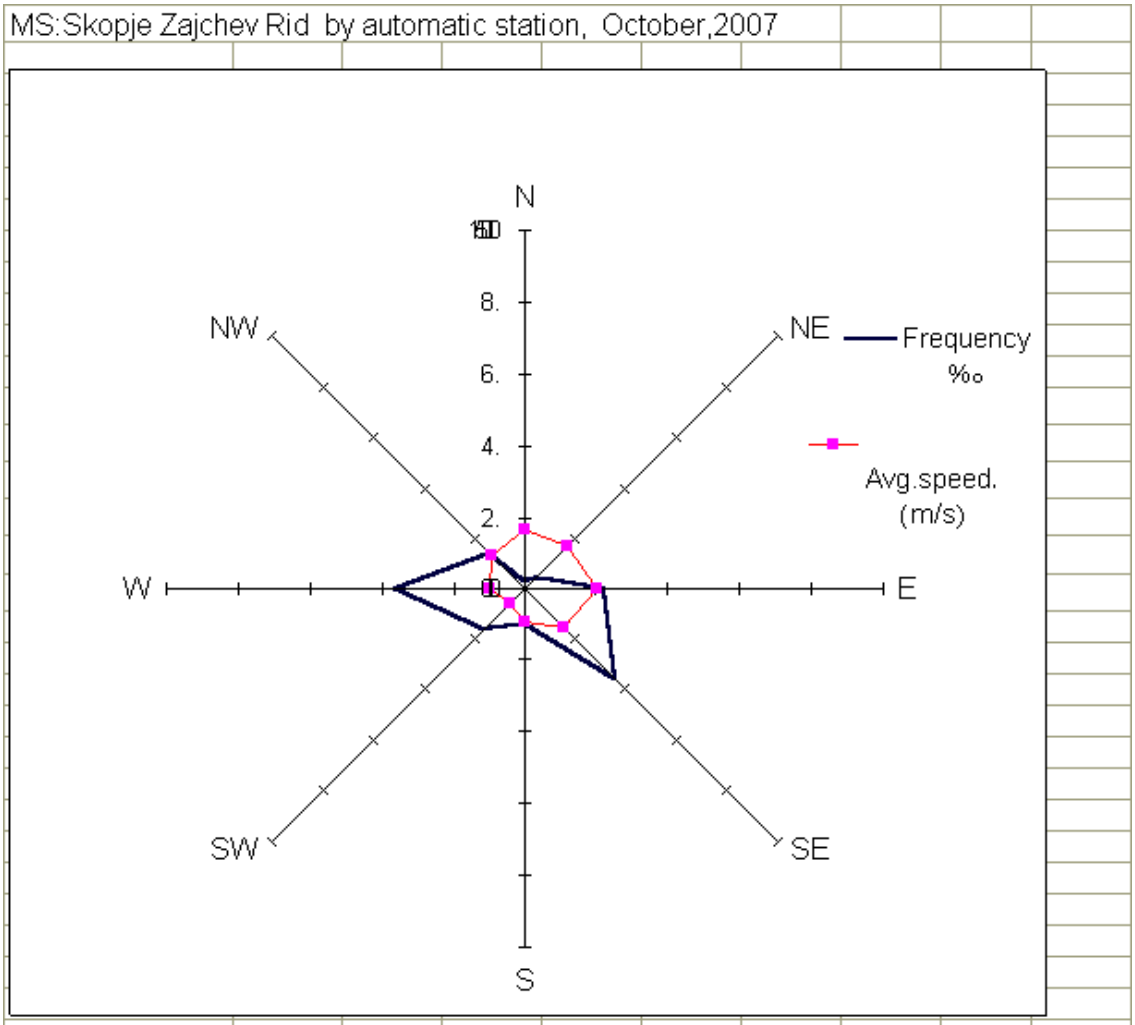
Figure 4 Monthly rose and wind speed in 8 directions, by hourly data (25m above the ground); M.M.S. Skopje Z.R., October 2007 - anemograph



Правец	C(тишини)	N	NE	E	SE	S	SW	W	NW
Честина во ‰	24	44	31	37	29	28	28	241	173
Ср. брзина м/сек	0	2.9	1.5	1.2	1.8	1.8	1.6	1.9	2.4

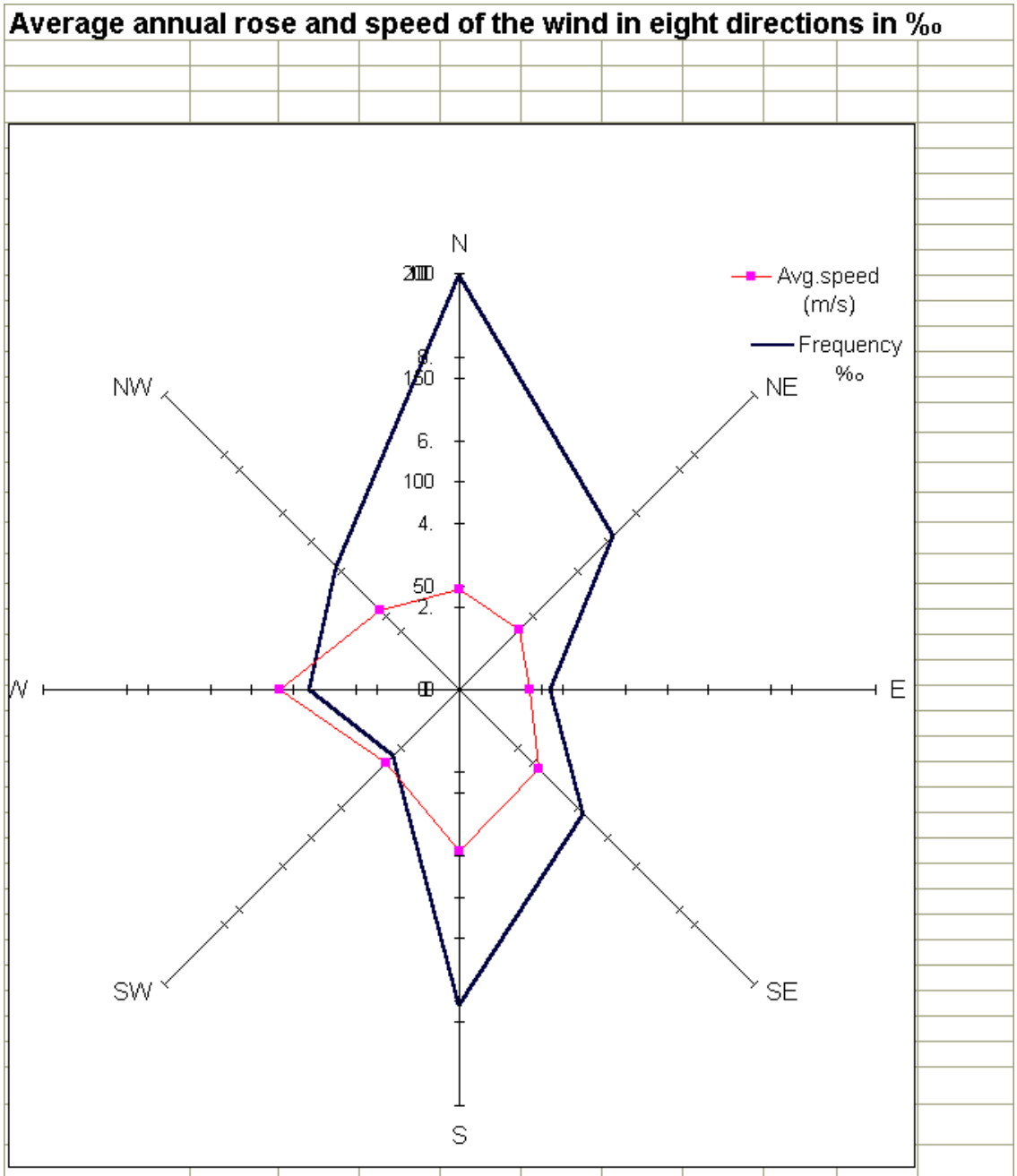
Figure 5 Monthly rose and wind speed in 8 directions, by climatologically data

M.M.S. Skopje Z.R., October, 2007 – automatic sensor



Direction	C(calm)	N	NE	E	SE	S	SW	W	NW
Frequency	23	1	2	11	18	5	8	18	7
Avg.speed m/sek		1.7	1.6	2.0	1.5	0.9	0.6	1.0	1.3

Figure 6 Average annual rose and wind speed in 8 world directions, by climatologically data anemograph



Direction	C(calm)	N	NE	E	SE	S	SW	W	NW
Frequency ‰	228	200	105	44	85	152	45	72	83
Avg.speed m/sek		2.4	2.0	1.7	2.7	3.9	2.5	4.3	2.7

Estimated data from Climatologically terms (07, 14 and 21) according the local time, from figures 1 and 2 are shown with rose on figures 3 and 5. Figure 3 wind rose shows that on 25m above the ground most frequent wind during the month October is the northwest and west wind. The northwest wind is with the biggest monthly average speed (2.9 m/s). On figure 4 can be noticed similarity with the rose on figure 3. This roses shows wind frequention by data with different temporal resolution (07,14 and 21) and every hour. But on figure 4 clearly can be viewed that the most frequent wind is from west direction but the north wind is with the biggest monthly average speed (2.9m/s).

From figure 5 is noticed that the most frequent wind on 10m above the ground is wind from west and southeast direction. The biggest monthly average speed during the October month, 2007 is 2.0 m/s, characteristically for the east wind.

On figure 6 average annual rose of the wind is exposed. This diagram is done by Climatologically data that are measured with anemograph, and processing is with application KLIINFO-w.

Application

Goals of the Climatological monitoring is to describe the Climatological system condition, and with the determinate referent period to compare. Part of the results (link) from the Climatological monitoring is map with real, average values, deviations from long series, average values or other cases. Comparing with the well famous (link) meteorological extreme records is most important, in direction to be possible to make classifications.
Reports for special, characteristic weather phenomena are other tool for describing the climate condition. In this reports interesting meteorological phenomena's are described in more details. Annual diary every year gives attenuation to characteristic happening in nature, important for the expired year; also do compare data like indicators for the Climatological characteristic (meteorological processes).
All this activities can be established using application KLIINFO-w as much as in small and in big services centres, for Climatological and forecast purpose. Creating and connecting the KLIINFO-module with certain data base systems the needs of different users can be solved.

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