

## DETERMINATION OF THE POPULATION SETTLEMENTS IN NDJAMENA BASED ON THE ANALYSIS OF THE FREQUENCIES OF THE WIND CHARACTERISTICS. PERIOD FROM 1983/1984 TO 2010

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### Abstract

This work solves the problem of determination the population settlements in Ndjamen and surroundings on the basis of the time frequencies of the characteristics of wind registered in this area, i.e. direction and velocity of the wind. It clearly indicates that the safety zone for the population settlements is included between the NE and E directions, assuming that there is no factories and industries in other localities situated before this area. So, industries and factories should be built in the domain between SW-W directions. To preserve populations from danger, the next settlement points behind this industrialized zone should be chosen taking into account the velocity of wind.

**Keywords:** Population settlements, frequencies, wind characteristics, convection, advection, direction, velocity, cardinal points.

### INTRODUCTION

Wind plays a very important role in many atmospheric phenomena. So, the convection is one of the main factors in the formation of clouds and precipitations. The advection is important in the horizontal distribution of the aerosols contained in the air. Wind has an impact in the regulation of the temperature and the relative humidity of the air. Some powerful wind has a very negative impact on the environment, as it destroys everything when blowing; in this category, tropical cyclones should be recalled, between others. It is obvious that the field of winds should be always under permanent observations in order to control its time-space distribution and evolution, and also to take on time necessary measures when such destructive ones as cyclones or hurricanes are forecasted. During these observations, the two characteristics concerning the wind are the direction which indicates from where the mass of air is coming to the point of observation and its velocity which tells us how fast it moves relatively to the earth surface. Usually the first characteristic is indicated relatively to the cardinal points, i.e. North-South or East-West orientations and the second one is given in meter per second (m/s). The analysis of the time frequencies of these characteristics from 1983/1984 to 2010, almost a 30 years period, should help the author in solving one daily encountered very important urbanization problem, the population settlements in order to protect them from pollutions coming from industries and factories, between others. In general, according to today international laws, the construction of industries in any locality should preserve the populations from pollutions of any nature. This implies some prior studies of the impacts resulting from the building of these factories. Their results will enable the authorities to approve or disapprove the implantation of these industries in a given area. These studies could be done only based on accurate meteorological information over the concerned locality. And the first needed information, between others, are the characteristics of the wind, whence the importance of the present work.

In developed countries this procedure seems to be regularly respected. In developing countries, the situation is likely worse for many reasons, between others, very weak density of meteorological stations, no adequate equipment, poor trained personnel, lazy attitude of the populations. Thus, very few publications in this domain have been done. This article, probably between the firsts for Ndjamen, is the contribution of the author to the resolution of the problem of the populations settlements in this city, whence its topicality. This work is divided into five sections. The first and present one is the introduction to the problem to be solved. The second one concerns a critical presentation of the data and the methodology used. The results and analysis are in the third section; the conclusion, recommendations and acknowledgement in the fourth. The references in the fifth section end this work.

### DATA AND METHODOLOGY

**Data:** Daily maximal wind velocities and their corresponding directions registered in Ndjamen during the period from 1983/1984 to 2010 were treated and conserved in tabular forms of monthly means at the National Meteorological Service in Ndjamen. As the direction concerned the maximal wind, the author was obliged to limit himself to this component.

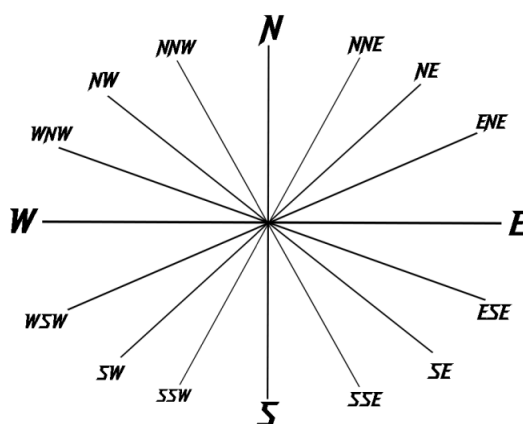


Figure 1. Different wind directions

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The direction and velocity were measured using a weather vane at the international airport of Ndjamená and situated at a distance of about 2.5 meters above the earth surface. The directions are: North (N), North-North East (NNE), North-East (NE), East-North East (ENE), East (E), East-South East (ESE) South-East (SE), South-South East (SSE), South (S), South-South West (SSW), South-West (SW), West-South West (WSW), West (W), West-North West (WNW), North-West (NW), North-North West (NNW), a total of 16 directions, conferred Figure 2.1. To the weather vane was added a calibrated parabola to estimate the velocity of the wind in meter per second, m/s.

**Methodology:** For a given month, the number of winds occurring in an interval of velocities and a particular direction was determined. This has permitted to obtain the table of the monthly frequencies of the wind characteristics and to find out the most favorite directions and range of velocities of the winds during the considered period.

**RESULTS AND ANALYSIS**

The results of data treatment are in Table 1. Here n and vv are the frequencies and the interval of variation on the velocities of the wind for a given direction, respectively. The two last columns are the corresponding yearly same data and their relative frequencies. Empty cases indicate that no wind was registered in the considered direction. For the whole period, a total of 243 monthly winds were registered.

From Table 1, more than 80% of winds in Ndjamená were globally from the North – East directions. Moreover, almost 45% were from NE-ENE directions with velocities in the interval 1.2–22 m/s (5.4–79.2 km/h). Very few winds were registered in the remaining directions. A powerful wind of velocity 48 m/s, 172.8 km/h, was registered in the WSW direction in June. In general, winds of velocities between 10 and 15 m/s, 36 and 54 km/h, were the most encountered. The author notes that the treated data does not reflect strong winds he used to observe particularly at the beginning of each season. These winds are such powerful that they break trees, take roofs away, destroy houses, carry all kinds of particles into the air. These winds should be compared to hurricanes and their velocity should exceed even 200 km/h. Based on this remark, the author estimate that this data is not accurate. Therefore, the present results should be considered as preliminary. The same remark has been done by others, (Njipouakouyou *et al.*, 2020). For what concerns the directions, they are coherent with the general atmospheric circulation in this geographic region, namely the Açores anticyclones. As the relief in the locality is roughly plane, without remarkable mountains and hills, it is clear that these characteristics of the winds should remain unchanged over a wide territory. These results should be taken into consideration when planning industrialization and population settlements in the city and surroundings. For Ndjamená, the populations should be settled in the area between the Northern and Eastern part of the city, and the industries and factories – between the Southern and Western part.

**Table 1. Time frequencies of the characteristics of the winds in Ndjamená for the period from 1983/1984 to 2010**

	Jan		Feb		March		April		May		June		July	
	n	vv	n	vv	n	vv	n	vv	n	vv	n	vv	n	vv
N	3	3.5-4.1	3	3.1-7	6	3.4-8	-	-	3	4.2-26	1	2.3	2	2.4-3.2
NNE	3	3.4-4.5	4	3.9-15	-	-	-	-	-	-	-	-	-	-
NE	13	2.5-15	10	11-12	8	4.4-17	5	2.6-13	4	2.3-7	8	2.5-12	-	-
ENE	1	7	7	4.1-20	4	3.9-16	-	-	3	3.2-12	3	3.2-20	1	12
E	3	4-14	3	1.2-8	-	-	13	3.2-20	3	3.1-22	6	4-23	3	3.6-22
ESE	1	3.2	-	-	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	3	2.7-11	3	3.6-9	3	3.2-11
SSE	-	-	-	-	-	-	1	2.3	3	3.3-23	-	-	2	2.5-28
S	-	-	-	-	-	-	-	-	-	-	-	-	4	3.2-18
SSW	1	8.8	-	-	-	-	-	-	5	2.9-18	-	-	-	-
SW	-	-	-	-	-	-	-	-	1	9	-	-	4	2.8-12
WSW	-	-	-	-	-	-	-	-	1	21	1	48	-	-
W	2	3.5-17	-	-	6	3.9-8	7	2.7-17	1	8	-	-	1	36
WNW	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NW	-	-	-	-	2	4.6-16	-	-	-	-	-	-	-	-
NNW	-	-	-	-	-	-	-	-	-	-	-	-	6	3.1-17

August	Sept		Oct		Nov		Dec		Year	%		
3	2.9-22	2	2.7-5	-	-	-	-	4	3-13	27	2.4-26	11.11
4	2-11	-	-	3	2.2-7	2	4-5	2	3.4-11	18	2-15	7.41
-	-	6	1.8-15	3	2.4-10	4	3-15	10	3.1-13	71	1.1-15	29.22
-	-	-	-	3	2-7	12	3.3-14	4	3.2-10	38	2-20	15.64
5	2.4-12	3	2.1-13	2	2-10	5	2.7-13	5	3.3-10	51	1.2-22	20.99
3	2.3-11	3	2.4-2.7	3	2.5-16	-	-	-	-	10	2.3-16	4.12
-	-	4	2.1-13	-	-	-	-	-	-	13	2.1-13	5.35
-	-	1	21	1	12	-	-	-	-	8	2.3-28	3.29
-	-	-	-	1	9	-	-	-	-	5	3.2-18	2.06
-	-	3	2.1-8	-	-	-	-	-	-	9	2.1-18	3.70
1	8	-	-	-	-	-	-	-	-	6	2.8-12	2.47
-	-	-	-	-	-	-	-	-	-	2	21-48	0.82
3	2.4-6	1	7	3	4-15	1	4	-	-	25	2.4-36	10.29
-	-	2	2.1-5	2	3.2-5	-	-	-	-	4	2.1-5	1.65
4	2.2-22	-	-	3	2.4-24	-	-	-	-	9	2.2-24	3.70
4	2.4-11	-	-	1	2.2	-	-	-	-	11	2.2-17	4.53
										Σ=243		

To settle the populations behind the industrialized zone, authorities should take into account both the wind velocities which could carry particles from their sources to a new settlement points and the nature of these substances. Building factories in the remaining areas of Ndjamena is not recommended as the absence of winds should bring to the accumulation in the air of rejected by factories substances which should be dangerous for the inhabitants.

### Conclusion

This study has permitted to determine the safety zones for the population settlements in Ndjamena and surroundings. Despite the fact that the wind velocities contain a certain degree of doubt, the directions are coherent to what generated by the existing synoptic information.

Similar studies should be done when planning industrialization of any locality in order to protect populations from pollutions which should bring them a lot of diseases. Also, effort in creating many meteorological stations for collecting needed information and in training specialists in meteorology should be done in developing countries.

### REFERENCES

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