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RESEARCH ARTICLE

PRELIMINARY INVESTIGATION OF THE FREQUENCIES OF THE MONTHLY MEAN VELOCITIES OF THE WIND IN NDJAMÉNA DURING TWO CONSECUTIVE CLIMATIC PERIODS: 1951 – 1980 AND 1981 – 2010. COMPARATIVE STUDY

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ABSTRACT

Investigating the frequencies of the monthly mean velocities of the wind in Ndjaména during two consecutive climatic periods and comparing the results have permitted us to come to the next main conclusions. Since the winds of velocities in the interval [0, 2.5[were predominant during the first climatic period compared to the ones of velocities in the interval [2.5, 5.0[, and inversely during the second climatic period, we conclude that the wind velocities were increasing with time in Ndjaména, indicating that the atmospheric turbulences were progressively increasing. As these velocities were allover below 18 km/h, it is obvious that these turbulences could be classified as moderated. In fact, visual observations made by the authors have indicated winds with velocities far above what given by the present data, particularly at the beginning of each season. Consequently, our results should be considered as preliminary.

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INTRODUCTION

The wind plays an important role in many atmospheric phenomena. The advection, horizontal wind, could be considered as the regulator in the distribution on the horizontal plane of various substances in the air, avoiding such a way their accumulation in one locality. It also causes the soil destruction through the erosion. And this negatively affects agricultural activities. The convection, vertical wind, plays almost the same role on the vertical plane and contributes a lot in clouds and rain formations which are very important in agriculture, between others. The agricultural productivity at certain degree depends on the wind. So the wind can be variously appreciated, positively or negatively, depending on its velocity. When it is over some critical value, its consequences could be very disastrous. One should recall the case of cyclones and typhoons which bring a lot of socio-economic destructions estimated in billions of US dollars after their passage in a region.

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Another characteristic of the wind is its direction which indicates from where comes a mass of air to the point of observation. This information is very important when planning the settlement of populations and the construction of factories and other sources of pollution in a locality. Recent investigations on the characteristics of the wind, velocity and direction, and their different impacts, have been made for some localities including the sahelian zone between others, (Amadou et al., 2018). In this study, used data series were not sufficiently long. One should have a permanent look on the wind regime in order to predict and avoid, if possible, disasters to be caused by powerful winds such as hurricanes, typhoons and cyclones. The present work is situated in this context. It should give us some information on the wind velocities in Ndjaména during the period from 1951 to 2010, two climatic consecutive periods, the first one from 1951 to 1980 and the second – from 1981 to 2010. Thus, the whole period of investigation is 60 years, sufficiently long enough to give acceptable results. This paper has five sections. The first and present one concerns the problematic of study. The second is about the data and methodology. In the third are the treatment of the data and the analysis of the results. In the fourth we

have the conclusion and acknowledgements. At last the fifth presents the references.

DATA AND METHODOLOGY

Data: The monthly mean velocities of the wind presented in tabular forms and generated by the numerical treatment of the regular daily observations at the meteorological station of the international airport of Ndjaména, Chad, were considered. The wind velocity was estimated by a weather vane. Observations were done at least 5 times a day. This instrument gives only rough values of the wind velocities. Moreover, the meteorological station is surrounding by trees and buildings which could seriously affect the measurements. Usual visual observations made by the authors have indicated that at the beginning of each season, particularly from June to August and from November to January, very strong and powerful winds blew in the city, braking tree-branches and trees, destroying roofs and houses, affecting electric lines, between others. By that time the atmosphere was full of dust and other particles. This situation could stay for hours and even days. For a wind to have such impacts, its velocity should be over 20 meters per second. Our data did not reflect these turbulences, whence the doubt emitted by the authors and the preliminarily aspect of the present work. As acceptable qualified personnel works at the station, the authors have assumed that this data could contain only systematic errors and thus, the present study could be done. So, our results should be considered as preliminary and should be latter achieved with more accurate data.

METHODOLOGY

For more detailed information, each climatic period was divided into three equal sub-periods: 1951-1960, 1961-1970, 1971-1980 and 1981-1990, 1991-2000, 2001-2010, and the wind velocity-in two equal intervals of length 2.5 m/s each, G1= [0; 2.5[and G2=[2.5; 5.0]. The frequency of the velocities of the wind in each interval during a given sub-period was determined. Tables of frequencies of the monthly mean velocities of the wind were built.

The yearly mean frequencies and their correspondent standard deviations were also determined to have an idea on their annual variability. Similar work was done for the full climatic periods. This study has highlighted the time variability of the wind velocities inside each climatic period and has permitted to compare climatic periods between themselves.

RESULTS AND ANALYSIS

The frequencies of the monthly mean velocities of the wind in Ndjaména are presented in Table 3.1. It indicates that during the first climatic period, winds of the first group, G1, were more frequent than the ones of the second group, G2. Relatively to G1, maximal frequencies were observed from August to December, April to December and April to November during the first, second and third sub-periods, respectively. Absolute maximums were registered from August to November. Minimal frequencies were in the remaining time, with absolute minimums usually around February. For the winds of the second group, G2, its frequencies did not exceed 6 during all the sub-periods of the first climatic period. Their maximal frequencies occurred from January to May. For the second climatic period, similar treatment has indicated that the wind velocities have increased considerably. The higher frequencies of the winds of group G2 confirmed this fact. Their frequencies were usually between 8 and 10 from January to July and from November to December. Minimal frequencies were observed from August to October. For the winds of G1 their frequencies did not exceed 7. The used encountered maximum, 6, was observed from August to October. During the remaining months, these frequencies were between 0 and 2. Thus, it is obvious that the second climatic period in Ndjaména was more turbulent than the first one, indicating the time increasing of the wind velocities in this locality. For the winds of G1, the yearly frequencies, N, means, n, and corresponding standard deviations, σ, for the first climatic period, first, second and third sub-periods were respectively 90, 8 and 2, 106, 9 and 1, 89, 7 and 1. Corresponding values for the winds of G2 were 30, 3 and 2, 14, 1 and 1, 7, 1 and 1.

Table 3.1 Frequencies of the monthly mean velocities of the wind in Ndjaména for the period from 1951 to 2010. 1e and 2e CP = first and second climatic periods, 1951-1980 and 1981-2020, respectively. G1=[0; 2.5[, G2=[2.5; 5.0].

			Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	N	n(σ)
1e CP	1951-1960	G1	9	7	4	5	4	7	6	10	10	10	9	9	90	8(2)
		G2	1	3	6	5	6	3	4	0	0	0	1	1	30	3(2)
	1961-1970	G1	8	6	7	9	9	8	10	10	10	10	10	9	106	9(1)
		G2	2	4	3	1	1	2	0	0	0	0	0	1	14	1(1)
	1971-1980	G1	7	5	7	8	8	7	8	8	8	8	8	7	89	7(1)
		G2	1	3	1	0	0	1	0	0	0	0	0	&	7	1(1)
2e CP	1981-1990	G1	1	1	1	2	2	0	1	5	6	6	0	0	25	2(2)
		G2	9	9	9	8	8	10	9	5	4	4	10	10	95	8(2)
	1991-2000	G1	0	0	0	1	2	0	1	6	7	6	1	0	24	2(3)
		G2	10	10	10	9	8	10	9	4	3	4	9	10	96	8(3)
	2001-2010	G1	0	0	0	0	1	0	1	6	6	6	0	0	20	2(3)
		G2	10	10	10	10	9	10	9	4	4	4	10	10	100	8(3)

Table 3.2. Monthly frequencies of the monthly mean velocities of the wind during the two consecutive climatic periods in Ndjaména

		Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1e CP	G1	24	18	18	22	21	22	14	28	28	28	27	25
	G2	4	10	10	6	7	6	4	0	0	0	1	3
2e CP	G1	1	1	1	3	5	0	3	17	19	18	1	0
	G2	29	29	29	25	27	30	27	13	11	12	29	30

In the second climatic period, these values were respectively for G1: 25, 2 and 2, 24, 2 and 2, 20, 2 and 3; and the winds of G2: 95, 8 and 2, 96, 8 and 3, 100, 8 and 3. These results indicate that during the first climatic period the winds were more stable than during the second climatic period. This was due to the fact that during this second climatic period the atmosphere was more turbulent. Table 3.1 shows that during the whole period of study the wind velocity in Ndjaména did not reach 6 m/s, (21.6 km/h). Visual observations made here by the authors have indicated recurrent very strong and destructive winds in certain periods of the year. Table 3.2 shows the monthly frequencies of the monthly mean velocities of the winds in Ndjaména from 1951 to 2010. It has permitted to compare the two climatic periods. So winds of G2 were more frequent in 2e CP than in 1e CP. Moreover, the predominance of the winds of G1 in 1e CP and the winds of G2 in 2e CP indicates that the wind velocities were increasing with time. If this tendency is kept, inhabitants of this city should prepare themselves to progressively more powerful winds with such impacts as soil erosion, between others.

Conclusion

In 60 years, the monthly mean velocities of the winds in Ndjaména did not exceed 18 km/h, (5 m/s).

In the first climatic period, winds of velocities less than 9 km/h, (2.5 m/s) were more frequent. In the second climatic period, winds of velocities between 9 - 18 km/h, (2.5 - 5 m/s), were more frequent. These conclusions do not fit with some observations made particularly at the beginning of each season when very destructive winds used to be observed in Ndjaména obliging the populations to wear protecting masks against all kinds of particles in the air. Our data did not reveal this particularity and this is why our results should be considered as preliminary. The authors cease this opportunity to extend their sincere thanks to the “Laboratoire de Physique de l’Atmosphère, Climat et Environnement” (LAPACE) of the Department of Physic, Faculty of Pure and Applied Sciences, University of Ndjaména, for their financial support. They do hope that this collaboration should always go forward.

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