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Analytical Study of climate changes effect on wind speed in Al- Nasiriya, Iraq

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Abstract

The ambient temperature is the major parameter that influences wind speed. When temperature rises, air will be extended and wind will flow with different speeds in all directions, increasing of temperature means that wind speed will be increased and vice versa. The relative humidity and atmospheric pressure affected with temperature, too. Climate changes making significant effects on the atmospheric temperature. In this project, the data of thirty four years (1981 – 2004) has been analyzed to get an idea about the changes occurred in the meteorological parameters in Al-Nasiriya city, which was chosen because it has a distinctive wind speed.

Keywords: Meteorological Data; climate changes; Al-Nasiriya.

دراسة تحليلية لتأثير التغيرات المناخية على سرعة الرياح في الناصرية ، العراق

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الخلاصة

درجة الحرارة المحيطة هي المتغير الرئيسي الذي يؤثر على سرعة الرياح. عندما ترتفع درجة الحرارة، سيتمدد الهواء وسوف تتدفق الرياح بسرعات مختلفة في جميع الاتجاهات، وزيادة درجة الحرارة يعني أن سرعة الرياح سوف تزداد والعكس بالعكس. الرطوبة النسبية والضغط الجوي يتغيران بتغير درجة الحرارة، أيضا. التغيرات المناخية لها آثار كبيرة على درجة حرارة الغلاف الجوي. في هذا البحث، تم تحليل البيانات الأنوائية لـ ٣٤ عاما (١٩٨١ – ٢٠٠٤) للحصول على فكرة عن التغيرات التي طرأت على العناصر الجوية في مدينة الناصرية التي اختيرت بسبب وجود سرع رياح مميزة فيها .

Introduction

Climate change means a change of climate due to human activities that alter the nature atmosphere components as well as natural effects like volcanic activities [1]. It is one of the major challenges of our time and adds considerable stress to our societies and to the environment. Climate change could occur naturally as a result of a change in the sun's energy or Earth's orbital cycle (natural climate forcing). [2]

Climate is always changed in different locations of the world. Evidence shows that climate has changed in the past, and nothing suggests that it will not continue to change [3].

At the ends of nineteenth century, the average global temperature began to rise. in the period between 1900 and 1940, average temperature of the lower atmosphere rose nearly 0.5°C [4]. The warming trend continued into the 1990s.The recent years being among the warmest of the twentieth

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century [5]**.** An increasing rate of warming has particularly taken place over the last 25 years, and 11 of the 12 warmest years on record have occurred in the past 12 years [6].

It needs to act urgently to avoid an irreversible build-up of greenhouse gases (GHGs) like CO_2, Methane, Nitrous oxide, Halocarbons as well as water vapor [7]. These gases trapping the sun's heat and causing the planet to warm up, which leads to increase the atmospheric temperature [8]. Many researches have been achieved to study the climate change in different locations of the world. Climate models predict that global temperatures could rise by a further 1–5 ^{o}C over the next 100 years, depending on GHGs amounts emitted and the sensitivity of the climate system [9].

The increment of temperature influencing the meteorological parameters like pressure, relative humidity, and wind speed [10]. Wind speed is strongly influenced by temperature rising, because it increases according to the increasing of temperature difference between any two sites. Wind speed plays a significant role in the field of energy generation by using wind turbines[11]. Wind energy is one of several kinds of renewable energy, which is considered as a clean, sustainable, and cheap energy in comparing with other sources of energy [12]. Al-Nasiriya Site (In Al-Nasiriya City), Southern of Iraq has been chosen to be studied in this work as a region of interest (ROI), according to its distinctive mean wind speed. It is the main city in the province of Dhi Qar, it is located at the intersection of Eastern longitude 31^{o} 15.19′ and Northern latitude 46^{o} 47.13′, as shown in Figure-1.

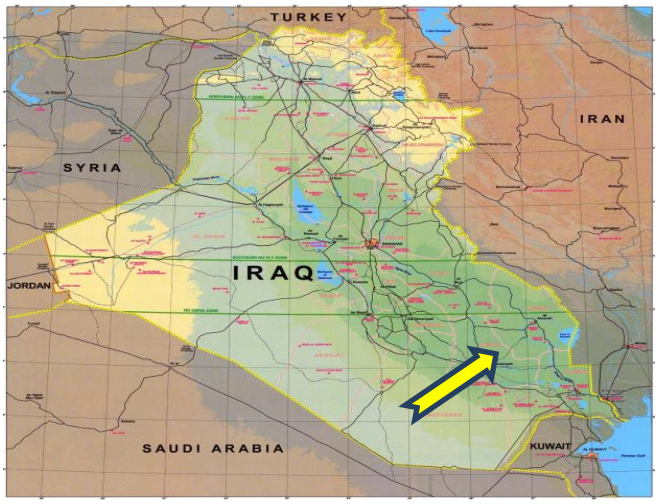

Figure 1- Iraqi map shows Al-Nasiriya Site.

Methodology

The time series of average monthly and annual wind speed, air temperature, relative humidity, and air pressure data, for 34 year (1981-2014) have been analyzed in this work. These data were obtained from Iraqi meteorological organization and seismology for Al- Nasiriya station. The data have been drown to be observed and discused in order to determine the real behavior of the meteorological prameters that mentioned previously.

Result and Discussion

Although the average temperature at any one place may vary considerably from year to year, the earth's overall average equilibrium temperature changes only slightly from one year to the next. This fact indicates that, each year, the earth and its atmosphere must send off into space just as much energy as they receive from the sun. The same type of energy balance must exist between the earth's surface and the atmosphere. That is, each year, the earth's surface must return to the atmosphere the same amount of energy that it absorbs. If this did not occur, the earth's average surface temperature would change.

The annual mean air temperatures recorded of the earth's surface in Al-Nasiriya Site are drown in Figure – 2.It is evident that there is increasing in temperature during the studied period. The blue curve shows the actual behavior of temperature for each year, while the black line refers to the general trend of temperature. Then, there are warming trend during the last thirty years, the temperature rises about 4 degree. It is easy to justify this result because the (ROI) has been suffered from continuous wars

during the studied period as well as draining of the local marshes which allows to existence of desertification.

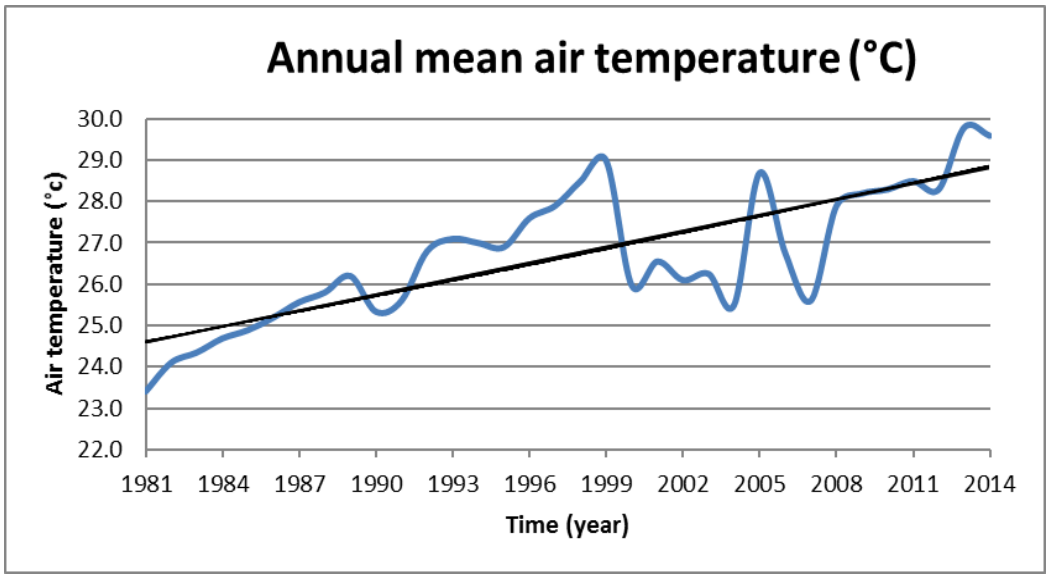

Figure 2- Changes in air temperature in Al-Nasiriya from1981to 2014.

At the other hand, the relative humidity (R.H) being decreased when the air temperature increased, that's because R.H denotes the ratio of the amount of water vapor actually present to the amount of water vapor required to saturate the air. Then, if the temperature raises, the saturation level rises, too, and leading to less percentage of water vapor, hence less R.H. So, for the same amount of moisture content, the increase of temperature leads to less R.H value. These facts are illustrated in Figure–3 during the period between 1981-2014.

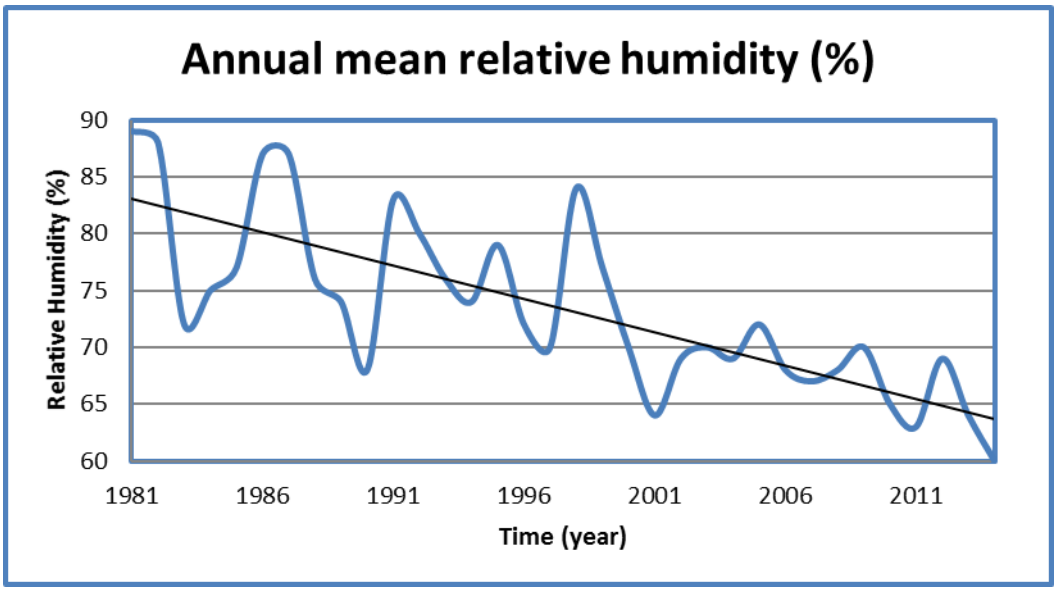

Figure 3- Changes in the surface air relative humidity from 1981 to 2014.

Figure-4 shows the behavior of atmospheric pressure (in mb) during the studied period. It is evident that temperature decreasing leads to decrease in atmospheric pressure, because the decrease of air. The decreasing of air density means that the weight of air column will be less than that at low temperature, and the pressure will be reduced.

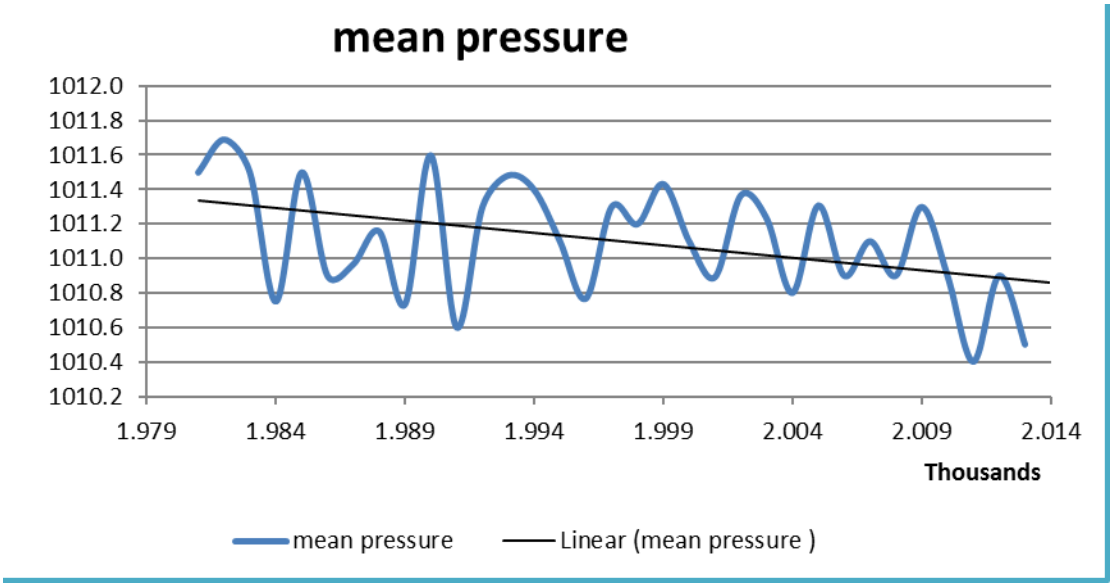

Figure 4- Changes in the atmospheric pressure (mb) from 1981 to 2014.

The wind speed at the duration of 1981- 2014 is trend to increase, as shown in Figure-5, this is according to the increment of air temperature and decrement of atmospheric pressure. When air temperature increases, the atmospheric pressure decrease causing laminar and turbulent flow as well as gusts sometimes, Generally, wind speed increased about 2 m/s during the studied period.

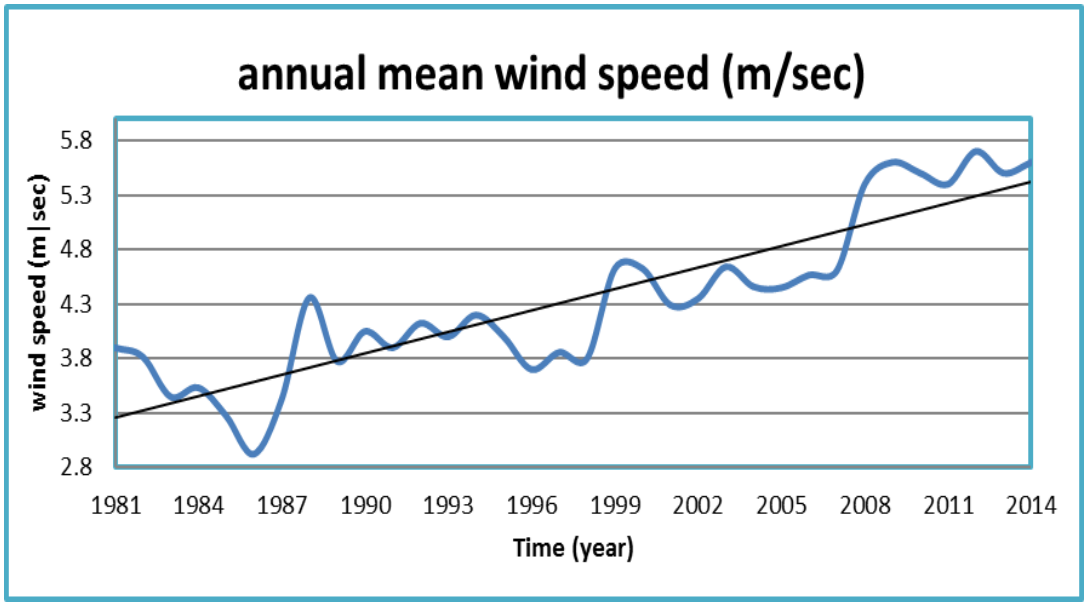

Figure 5- Changes in the surface wind speed from 1981 to 2014.

At the other hand, the studied meteorological parameters like air temperature, relative humidity, atmospheric pressure, and wind speed, are not changed in their monthly behavior. The general behavior for each month along the studied period is the same of that of one year. Figure-6 illustrate the behavior of the air temperature during a year, the value of air temperature, of each month represents the mean value of that month during the studied period. Generally, at the ROI, the temperature raises at summer while it is dropped at other seasons, this behavior has been seen at the monthly mean air temperature.

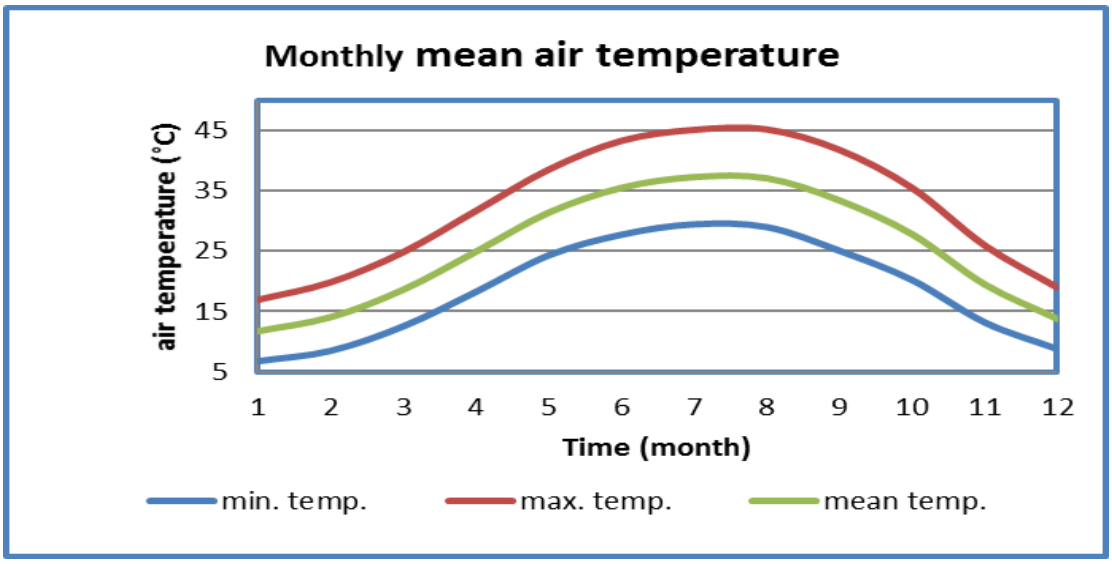

Figure 6- Air temperature behavior during the year.

The same method is applied for other studied meteorological parameters. The Figures-(7, 8, and 9), show the behavior of relative humidity, atmospheric pressure, and wind speed during the year.

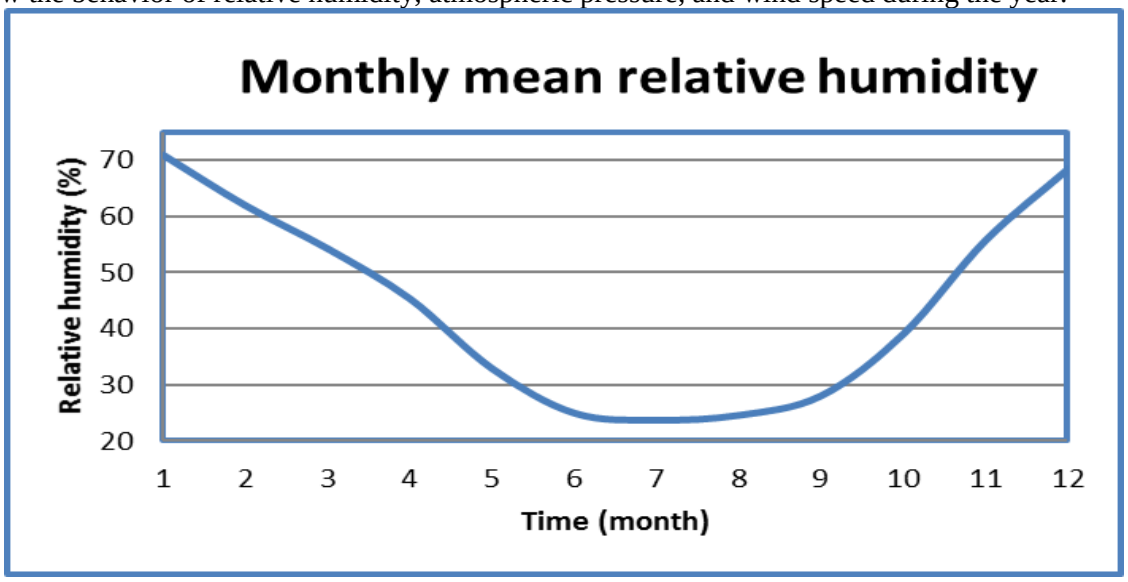

Figure 7- Relative humidity behavior during the year.

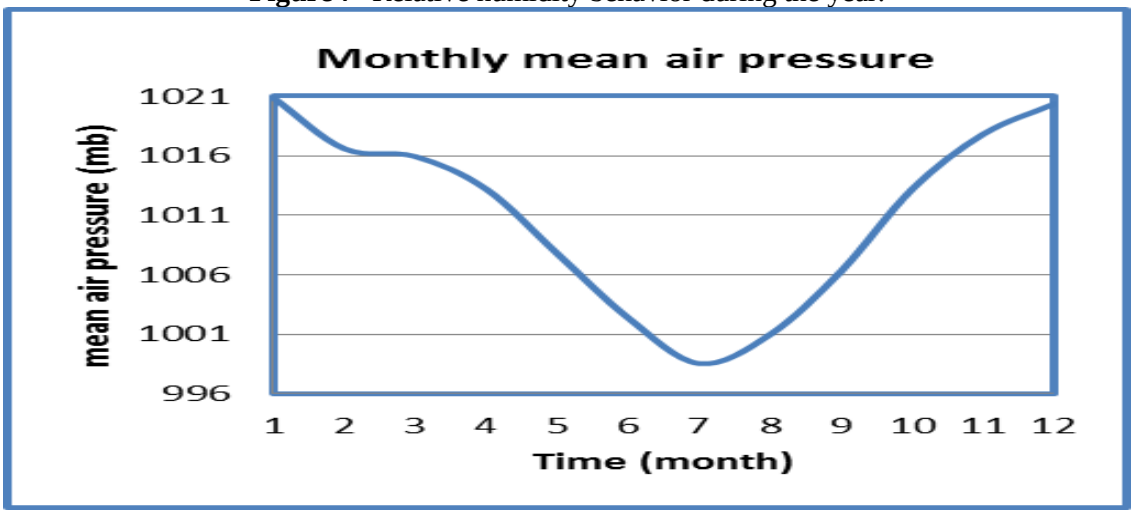

Figure 8- Atmospheric pressure behavior during the year.

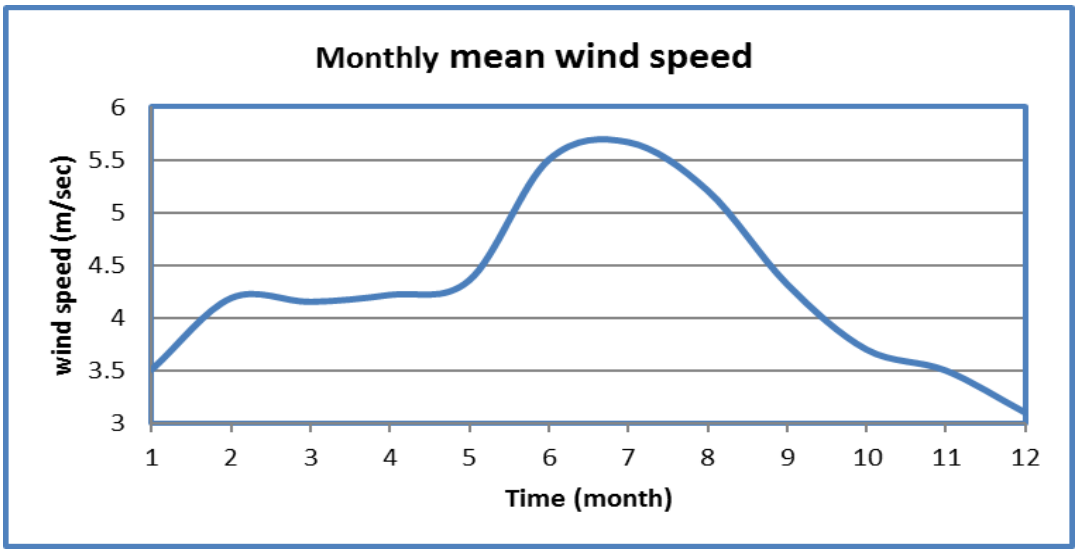

Figure 9- Wind speed behavior during the year.

Conclusion

1 – It is evident that air temperature increased at about 4 ^{o}C in the ROI because the continuous wars in this location as well as the desertification which is occurred after the draining of the local marshes .
2 – Increasing of air temperature allows to decrease each of the relative humidity at about 20% and the atmospheric pressure at about 0.5 mb, while the average wind speed increased at about 2 m/s .
3 – The annual behavior of the studied meteorological parameters is the same of the behavior of each parameter individually, during the year.

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