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Bioclimatic Assessment of Weather Condition for Recreation in Health Resorts

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Abstract: The atmosphere is part of the environment in which the human body constantly seeks balance with the external environment. The reaction of an organism is a response to various physics and chemical processes in the atmosphere. By analyzing these aspects of environment, relevant to health, there is variety of complex effects presented with the bioclimatological indices. One of those indices is humidex used to describe how hot the weather feels to the average person by combining heat and humidity. The aim of the paper is to present how weather variables come together in order to give a elementary climate meaning for recreation within the health tourism. In this analysis, daily meteorological data were used for two extreme warm months, July and August (weather station in Banja Luka). The final results show distribution of different degree of comfort caused by actual weather conditions. The idea is to show how weather can be evaluated for recreational needs in the health resorts around the city of Banja Luka.

Key Words: Bioclimatological indices, humidex, recreation, health tourism

1. Introduction

The atmosphere is part of the environment in which the human body constantly seeks balance with the external environment. The reaction of an organism is response to various physics and chemical processes in the

atmosphere. By analyzing these aspects of environment, relevant to health, there is variety of complex effects presented with the bioclimatological indices.

Thermal environment is one of those effects that combine heat and humidity which is explained by humidex. Humidex is bioclimatic

index represent an external subjective temperature felt by a man in hot and humid environment. Humidex is used as a measure of heat that results from excessive moisture and high temperatures. The basic assumption is that humidex represent our feeling that the air temperature is higher than air temperature in environment. According to Masterton and Richardson, humidex formula supports this assumption. For air temperature above 7°C humidex will be higher than air temperature. For air temperature below 7°C humidex will be lower than air temperature which means that basic assumption about subjective feeling is not full filled. Therefore, humidex is limited for summer.

Moisture is very important in relation to the human organism and the environment. The body tries to maintain a constant internal temperature of 37°C any time. When is warm, the body produces sweat which cooling the body so it evaporates. Evaporation stops entirely when the relative humidity reaches about 90%. Under these circumstances the body temperature rises and can cause a certain level of thermal discomfort.

Humidex provides a number that represent how hot people feel. Table 1. present the humidex range and degree of comfort.

Table 1. Humidex range and degree of comfort

Humidex Range	Degree of Comfort
less than 29	Comfortable
30-39	Some discomfort
40-49	Great discomfort, avoid exertion
45-54	Dangerous
Above 55	Heat stroke imminent

Source: EnvironmentCanada: http://www.wul.qc.ec.gc.ca/meteo/documentation/Humidex_a.html

Some discomfort zone shows that some fatigue and cramps is possible with prolonged and intensive physical activity. Great discomfort zone shows that heat cramps and heat exhaustion is possible so it is advisable to avoid exertion. The most dangerous zone shows that prolonged physical activity can lead to heat stroke. The idea of this paper is to show how humidex can help the subjective analysis

of the actual weather condition especially for recreation. In particular, it may be important for therapeutic recreation in health resort. For example, water loss from the body affects the thermoregulatory system and its ability to maintain central body temperature constant during heat stress and physical exercise. The main effect of water loss from the body is to raise the central body temperature. There is a linear increase in temperature for every percentage reduction of water in the body. However, increase in central body temperature due to dehydration also depending on the environmental factors. Increased temperatures and humidity result greater increase in central body temperature for a given level of dehydration. Considering that the body generates heat in the muscle activity, intensity of physical activity is also a factor that increases the body temperature in a state dehydration. If are temperature and air humidity known in any part of the day, than it is easy to make subjective assessment of weather condition.

In this paper daily meteorological data (weather station in Banja Luka) were used to calculate humidex. The calculations of the humidex were made using BioKlima 2.5 software package. In order to obtain more accurate results both, average daily air temperature and maximum daily temperature, were used. Thus, two values of humidex were obtained, humidex calculated with average daily air temperature (Ha) and humidex calculated with maximum daily temperature (H).

The daily meteorological data were analyzed for city of Banja Luka. Some of the spa and health resorts are situated close to the city of Banja Luka, like Spa Laktaši, Spa Slatina, Spa Kulaši and Spa Vrućica.

Banja Luka is the second largest town of Bosnia and Herzegovina and the largest town in the Republic of Srpska entity. It is located on the northwest of country and lies on the river Vrbas, altitude 153 m, in the southern part of the Banja Luka basin and it is surrounded by hills. The tributary rivers of the river Vrbas, Suturlija, Crkvena, and Vrbanja, flow into the Vrbas at Banja Luka. The city itself is built in the Banja

Luka valley, which is located at the transition between high and low mountain areas.

Banja Luka has a continental climate, with harsh winters and warm summers. The warmest month of the year is July, with an average temperature of 21.3 °C. The coldest month of the year is January, when temperature average near freezing at 0.8 °C. Annual precipitation for Banja Luka is about 988 mm. Banja Luka has an average of 143 rainy days a year.

2. Analysis of Results

Table 2 and table 3 present a day by day distribution of different degree of comfort caused by actual weather conditions in Banja Luka during five years. Meteorological data for two summer months, July and August, were analyzed.

Table 2. Humideks example in July during five years 2000-2004

July	2000		2001		2002		2003		2004	
	Ha	H	Ha	H	Ha	H	Ha	H	Ha	H
1	28	38	23	29	25	32	32	41	28	36
2	32	42	23	26	29	36	27	32	24	28
3	32	43	21	27	33	39	28	36	23	29
4	33	43	22	29	27	37	25	32	26	32
5	31	38	24	30	22	28	22	29	29	37
6	27	36	29	36	28	35	24	31	33	39
7	31	41	34	40	26	31	24	31	27	31
8	28	39	30	37	29	34	23	30	34	43
9	17	22	26	32	32	38	25	33	33	41
10	25	34	27	34	34	41	26	33	29	33
11	25	34	30	36	35	40	23	30	21	27
12	25	34	25	28	29	35	26	35	18	23
13	17	24	29	35	31	38	23	30	19	25
14	22	29	32	39	27	36	21	28	19	24
15	17	23	33	41	29	34	24	32	20	28
16	18	21	31	40	30	39	31	40	26	33
17	21	29	25	31	26	34	34	42	29	37
18	18	24	27	33	27	34	26	36	31	40
19	21	28	29	37	26	31	29	34	31	40
20	20	26	25	32	26	34	31	38	34	41
21	20	27	21	26	30	39	32	42	33	41
22	22	30	21	23	25	33	33	43	34	41
23	27	36	24	26	24	31	32	41	31	41
24	29	35	26	34	28	36	30	38	30	37
25	31	40	28	34	24	29	27	32	29	33
26	30	41	28	35	20	26	28	36	24	28
27	29	35	28	36	24	28	31	39	19	22
28	27	37	29	37	27	32	32	41	19	23
29	23	31	28	36	27	33	26	37	19	19
30	22	28	25	34	28	36	23	29	22	26
31	23	30	29	36	26	35	25	27	25	33

There is comfortable, some discomfort and great discomfort of subjective feeling represented in July during five years (Table 2.). It is observed slight domination of comfortable subjective feeling over the some discomfort while great discomfort is little present. Also, it is observed every year a slight increase the number of days of some discomfort calculated as Ha. There is also a slight increase of great discomfort in last two years. In August (Table 3.) there is some discomfort, great discomfort of subjective feeling and dangerous one. More subjective feelings are present with humidex calculated as Ha. It is also observed dangerous degree of comfort. Those results show that July has more days with comfortable subjective feeling compared with some discomfort, while great discomfort is present mostly in short heat waves of two or three days together.

Table 3. Humideks example in August during five years 2000-2004

Aug	2000		2001		2002		2003		2004	
	Ha	H	Ha	Ha	Ha	H	Ha	H	Ha	H
1	23	32	31	39	29	37	28	34	27	36
2	26	37	30	38	31	39	30	37	27	35
3	30	39	33	43	32	39	31	29	28	35
4	31	40	36	45	32	39	31	40	28	35
5	30	36	31	38	30	36	34	42	29	36
6	30	35	25	30	24	35	36	44	29	35
7	26	33	27	33	24	28	28	36	29	35
8	25	32	30	39	24	29	26	35	26	31
9	24	32	32	41	23	31	27	37	28	35
10	26	34	32	43	27	35	26	37	26	32
11	26	36	19	28	21	27	26	35	28	36
12	26	37	16	23	22	28	25	36	34	40
13	27	38	19	28	24	32	30	41	30	38
14	28	38	23	32	25	30	31	44	23	29
15	27	35	26	35	25	27	31	39	21	29
16	28	37	29	37	27	32	29	35	22	30
17	29	40	29	37	25	33	31	41	25	35
18	30	41	31	38	26	33	30	45	30	39
19	31	44	30	40	26	34	29	38	31	41
20	31	43	30	40	24	33	27	35	32	42
21	33	46	25	35	24	32	27	36	28	34
22	31	42	26	33	24	29	28	38	20	27
23	30	38	27	34	26	33	30	40	21	30
24	26	35	27	33	26	34	28	37	27	34
25	25	36	29	36	27	35	26	33	28	36
26	20	27	30	38	27	34	24	31	20	30
27	19	28	29	38	27	33	26	35	21	28
28	21	27	23	30	25	32	27	39	19	29
29	21	30	21	28	25	29	35	42	21	31
30	23	33	20	28	25	30	30	39	24	35
31	25	35	20	25	23	32	23	33	24	33

Only in year of 2004 there is a heat wave of six days with great discomfort subjective feeling. August has more days with some discomfort subjective feelings compared with comfortable subjective feelings. Great discomfort occurs in short waves of two or three days, except year of 2000 where it was longer heat wave with five days of great discomfort and one day with dangerous subjective feeling.

3. Conclusion

Bosnia and Herzegovina has several spa and health resorts based on the thermal or mineral springs, with different development and different tourism affirmation. Some of them are situated close to the city of Banja Luka, like Spa Laktaši, Spa Slatina, Spa Kulaši and Spa Vručica. In this paper is presented humidex combining the two basic meteorological elements, temperature and humidity, that gives subjective feeling about environment temperature. If are temperature and air humidity known in any part of the day, than it is easy to make subjective assessment of weather condition.

Analyzing meteorological data for weather station in Banja Luka it can be concluded that humidex as basic bioclimatic information could be very useful in spa and health resorts for those guests who have cure and heal treatment. In particular, it may be useful for therapeutic recreation in health resort.

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