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INDEX BIOCLIMATIC "WIND-CHILL"

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Abstract. This paper presents an important bioclimatic index which shows the influence of wind on the human body thermoregulation. When the air temperature is high, the wind increases thermal comfort. But more important for the body is the wind when the air temperature is low. When the air temperature is lower and wind speed higher, the human body is threatening to freeze faster. Cold wind index is used in Canada, USA, Russia (temperature "equivalent" to the facial skin) etc., in the weather forecast every day in the cold season. The index can be used and for bioclimatic regionalization, in the form of skin temperature index.

Introduction

In the relationship between climate - weather and the human body, wind, through its components, direction and especially speed is of great importance in the process of thermoregulation.

Thermoregulation is an important property of the body, keeping it internal temperature by the heat loss or the heat production, through the skin, depending on the external conditions. It is obvious that these processes depend primarily on ambient temperature, and moisture, as well as the dynamics of air.

It is known that high temperature stress to the body, and determine the reduction of temperature. Similarly a low temperature leads to the production of heating mechanisms.

The large amount of water vapor in the atmosphere, in high temperature conditions, gives a feeling muggy, unbearable. In contrast, under low temperature, feeling cold is more pronounced. In other words, a high moisture can cause thermal discomfort, so when it's hot and when it's cold.

Instead, the importance of the wind body is different from that of the moisture, namely under moderate wind, when the temperature is high, the wind cools the

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skin, replacing the hot air layer close to the skin, thereby reducing discomfort of the heat, but when the temperature is low, the wind stresses Thermoregulation.

In the calm atmospheric conditions, at low temperatures, the cold is felt appropriate to the temperature indicated by the thermometer. When the wind blows, the higher the speed is higher, the higher is thermal discomfort and the feeling cold is much higher than the thermometer indicates.

In Canada, and then in the United States, where winters are hard not only because of low temperatures, but of strong winds blowing from the North Pole, in addition to the known weather: temperature, relative humidity, wind speed and wind, precipitation, cloudiness, in the weather report was introduced and a specific bioclimatic index, i.e. "cold wind" (wind chill), accepted by the National Weather Service.

Wind Chill (cold wind) is the term that indicates the rate of heat loss of the human body the combined effect of low temperature and wind. The body loses heat by evaporation, convection, conduction and radiation. Wind-chill effect is that to increase the rate of heat loss and reduce skin temperature, and then the internal temperature of the body. So the air "feels" colder than it actually is, and therefore increases the risk of adverse effects such as frostbite on exposed areas, especially the extremities. This index can show the levels of severity of the winter.

1. Data and method.

Research has tried expressing this feeling of discomfort by cooling at different wind speeds. The first experiment was conducted by Paul Allman Siple and Charles F. Passel in 1945. They calculated cooling rate for a small plastic bottle suspended in the wind level with an anemometer on the roof of their hut in the Antarctic expedition. Since 1960 the method began to be used in the National Weather Service At first, it was though that can produce freezing at low temperatures, even in calm atmospheric conditions, which produced obvious exaggerations in establishing the severity of the weather. Later, Charles Eagan proposed taking into account only the cold wind at 1.8 m / s (4 mph), resulting in a more realistic index value.

In Canada the standard formula for wind chill is:

$$T_{\mathrm{wc}} = 13.12 + 0.6215T_{\mathrm{a}} - 11.37V^{+0.16} + 0.3965T_{\mathrm{a}}V^{+0.16}$$

where:

T_{WC} = wind chill index,

Ta = air temperature in ^{0}C,

V = wind speed (km/h) at 10m (the standard anemometer height), Equivalent formula in the U.S. is:

$$T_{wc} = 35.74 + 0.6215T_a - 35.75V^{+0.16} + 0.4275T_aV^{+0.16}$$

where:
T_{WC} = wind chill index
Ta = air temperature in ^{0}F
V = wind speed (mph).

$$T_{wc} = 35.74 + 0.6215T_a - 35.75V^{+0.16} + 0.4275T_aV^{+0.16}$$

The cold wind is defined by the temperature of 10^{0}C (50^{0}F) or less and a wind speed of more than 4.8 km / h = 1.3 m / s (3.0 mph).

2. Results and Discussions.

Method of calculation and application of this index is still controversial, because it could not establish an agreement if one takes into account the whole body, windy, especially in this case must take into account the clothing, or only the face that is exposed first. Matter and whether it snows or not, snowflakes wetting clothes and skin. Also it must be taken into account that the internal thermal resistance is individual. The formulas are so average state weather conditions with cold temperatures and wind.

2.1. Wind-chill.

We present below diagram (Fig.1) and table (Table 1) for determining the index at different values of temperature and wind

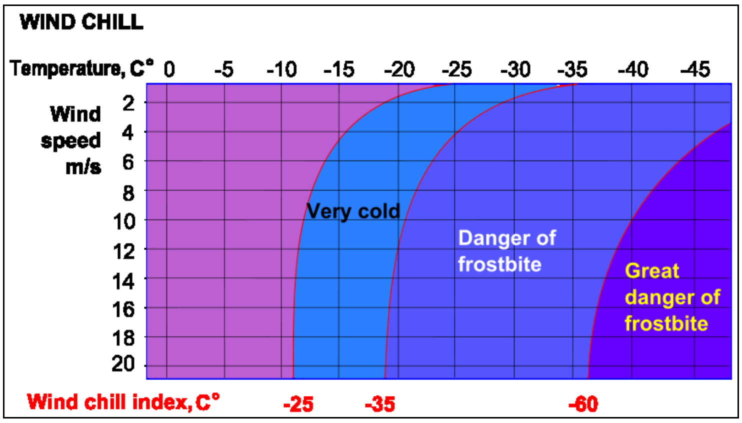

Fig.1 The diagram for determining the bioclimatic index “Wind chill”
(http://en.wikipedia.org/wiki/File:Windchill_effect_en.svg)

Tab.1 The bioclimatic index “Wind chill” calculated by converting ^{0}F to ^{0}C and mpf in m/s. At the Wind chill <-28^{0}C frost occurs in 15 minutes or less.

Temperature (^{0}C)																
m/s Calm	**4,4**	**1,7**	**-1,1**	**-3,9**	**-6,7**	**-9,4**	**-12,2**	**-15**	**-17,8**	**-20,6**	**-23,3**	**-26,1**	**-28,9**	**-31,7**	**-34,4**	**-37,2**
2,2	2,2	-0,6	+3.8	-7,2	-10,6	-13,9	-17,2	-20,6	-23,9	-26,7	-30	-33,3	-36,6	-40	-43,3	-46,7
4,5	1,1	-2,7	-6,1	-8,4	-12,8	-16,1	-20	-23,3	-26,7	-30	-33,3	-37,2	-40,6	-43,9	-47,2	-50,7
6,7	0	-3,8	-7,2	-10,6	-14,4	-17,8	-21,7	-25	-28,3	-31,7	-35,6	-39,4	-41,8	-46,1	-50	-53,3
8,9	-1,1	-4,4	-8,3	-11,7	-15,6	-18,9	-22,8	-26,1	-30	-33,9	-37,2	-41,1	-44,4	-48,3	-51,7	-55,6
11,2	-1,6	-5	-8,9	-12,8	-16,1	-20	-23,9	-27,2	-31,1	-35	-38,3	-42,2	-46,1	-50	-53,3	-57,2
13,4	-2,2	-5,7	-9,4	-13,3	-17,2	-20,6	-24,4	-28,3	-31,7	-36,1	-39,4	-43,3	+47.2	-51,1	-55	-58,3
15,6	-2,2	-6,1	-10	-13,9	-17,8	-22,7	-25,6	-29,4	-32,8	-36,7	-40,6	-44,4	-48,3	-52,2	-56,1	-60
17,4	-2,7	-6,7	-10,6	-14,4	-16,3	-22,2	-26,1	-30	-33,9	-37,8	-41,6	-45,6	-49,4	-53,3	-57,2	-61,1
20,1	-3,3	-7,2	-11,1	-15	-18,9	-22,8	-26,7	-30,6	-34,4	-38,3	-42,2	-46,1	-50	-53,9	-57,8	-61,6
22,4	-3,3	-7,2	-11,1	-15,6	-19,4	-23,3	-27,2	-31,1	-35	-39,8	-42,8	-46,7	-51,1	-55	-58,9	-62,8
24,6	-3,8	-8,3	-12,2	-16,1	-20	-23,9	-27,8	-31,7	-35,6	-39,4	-43,3	-47,8	-51,7	-55,6	-59,4	-63,3
26,8	-3,8	-8,3	-12,2	-16,1	-20,1	-23,9	-28,3	-32,2	-36,1	-40	-44,4	-48,3	-52,2	-56,1	-60	-64,4

At this table, it can be felt by the human body to calculate the value under different conditions of temperature and wind. Example: in March 2014 a few days the wind was stronger, leading to a cold feeling, more pronounced than it would have been natural, the temperature recorded at the thermometer:

- March 9, t.min. = 1^{0}C, v = **9.2** m/s, Wind chill = -4.4^0 C,
at the gust of wind = 15.6 m/s, Wind chill = **-6^{0}C**

-March 13, t.min = **-4^{0}C**, v = **2.2** m/s, Wind chill = -7.2^{0}C,
at the gust of wind = 5,6 m/s, Wind chill = -9.4^{0}C.

The authors state that an index exceeding -25^{0}C, freezing time is about 30 minutes, at -35^{0}C freeze time is 10 minutes and an index value of -45 ...-60^{0}C or less, body freezes in 5 minutes with clear pathogenic effects: freezing of the extremities, hypothermia and unless urgent action is taken, death.

We will add two additional issues relative to the influence of wind on the thermal comfort of the human condition and society.

2.2. *Skin temperature*.

Soviet researches were also concerned with the influence of wind speed on thermoregulation of the human body, and have proposed a diagram for determining the temperature "equivalent" to the facial skin, according to the air temperature and wind velocity. Thus we can calculate the possible freezing of face.

To freeze, skin temperature unprotected parts of the body must descend to 0ºC or below. Examples are given from different cities of European Russia and Siberia were calculated for periods of 20 to 30 year, period of temperature below 0 º C and the number of days it is possible to freeze the face.

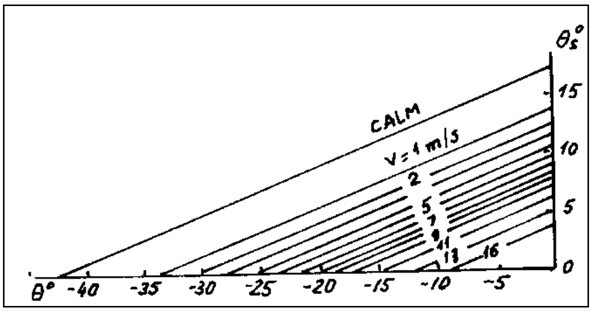

Fig. 2. Nomogram skin temperature values according to the temperature and wind. (Adamenko et al, 1972).

For example were: Leningrad 122 days with temperature <0 º C and 2 days with possible freezing of the face, Vladivostok 132 respectively 26 days and so on. Hence resulting conclusions on housing, so as to reduce the wind speed, and to prevent frost danger of children and adults during activities outside, in the region as Norilsk, Dickson, Magadan, Anadâr.

1.1. Stress skin.

Siple and Passel's formula was later taken over by JP Besancenot, 1974, which calculated the stress skin by formula:

$P = [10(v)^{1/2} + 10.45\text{-}v]\,(33\text{-}t)$

where:

P = cooling capacity kcal/m^2/h

V = wind speed in m/s

t = air temperature in ^{0}C

33-t = temperature difference between the normal (average) temperature of the skin and air temperature.

This formula has been used for the bioclimatic regionalization, establishing cutaneous stress. Thus it is considered that at the cooling power below 299 kcal/m^2/h index is hypotonic, causing stress by triggering thermolysis, in summer, while power cooling exceeding 600 kcal/m^2/h, index is hypertonic, causing stress by triggering thermogenesis, in winter. Between 300 and 599 kcal/m^2/h, the index is considered relaxing.

Based on this index, and the association with lung stress index, was calculated total bioclimatic stress in Romania, according to its variation with altitude, in relation with Balneology physician observations, establishing a tonic bioclimate stimulant to the mountains, a bioclimatic exciting for the plain and a sedative bioclimate sedative in the hills.

Conclusions.

"Cold Wind" is a bioclimatic index showing sensation felt by the human body under enhanced atmospheric dynamics.

Weather report is used to determine the severity of the winter.

The index can be used and for bioclimatic regionalization.

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