Temperature conditions in the all-season tourist and recreational complex “Veduchi”

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Abstract. The work is devoted to the study of temperature conditions in the territory of the recreation zone of the ASTRC “Veduchi”. The average monthly and annual air temperature values at various altitudinal zones were obtained. The climatic parameters values were determined as linearly dependent on the height of the terrain.

Introduction
In accordance with the Federal Target Program for the Development of Resorts of the North Caucasus in the Chechen Republic, the creation of the all-season tourist and recreational complex (ASTRC) Veduchi is planned.

The territory is located in the Itum-Kalinsky municipal district of the Chechen Republic in the area of the village Veduchi on the left and right slopes of a narrow V-shaped valley r. Khacharoyahk (in the area of its middle course) and, partially, within the adjacent watershed areas (the slopes of the Daneduk and Khacharoyduk ridges).

Main Part
The main tasks of the studies performed are a comprehensive study of the temperature conditions of the territory created by the Veduchi ASTRC. For this purpose, the archival data of the FSBU “VSI”, literary sources [1-4] were used. In preparing the article, the results of the engineering hydrometeorological and environmental engineering surveys [5, 6] were used with the authors’ participation. Hydrologically, the area of work is not well understood. The initial series of observations on the rivers of the area under consideration are unequal in their duration, since many hydrological posts are closed. The rivers of the region are typically mountainous, with steep sides abound in deep canyons and waterfalls. The rivers are filled by melting snow, rain and groundwater.

Results and discussion
The territory is within the limits of the mountain depression between the Lateral and Rocky ridges (see Figure 1). This is an extensive lowering of the relief, far extending beyond the limits of the study area. The formation of this relief type is associated with a relatively slow in this place uplifting of the earth's crust relative to the lateral ridge and the intense erosion activity of the widely branched hydraulic network. In terms of the main factors' combination, the site refers to a medium-mountainous, slightly
dissected relief with soft forms on dislocated Aalen and Upper Copper sand-clay sediments. Man-made violations of the relief in the area are widespread. Basically, the relief was formed in the Pleistocene-Holocene time.

The valley is erosion-accumulative, confined to the core of the Khacharyan anticlinal fold, where the rocks have an increased fracture and are easily eroded. The Khacharoydok ridge, the southwestern slope of which forms the right side of the Khacharoydok river, coincides along its entire length with the axial line of the Tushkhoroy syncline. The ridge is a linear positive structure, with altitudes of ~ 1200-1760 meters above the sea level, with a relatively soft outline of the summit.

The absolute marks of the territory of ASTRC Veduchi vary from 964 m to 2900 m.

Figure 1. The Daneduk Ridge in the Veduchi ASTRC Region

The territory refers to the climatic region II B according to the climatic zoning map for the construction (SP 131.13330.2012).

In terms of climate, the territory under consideration refers to the temperate zone of the mountainous region of the North Caucasus according to B.P. Alisov [2]. The formation of climatic conditions is influenced by the regional circulation of the atmosphere, the radiation regime and the nature of the underlying surface. However, the main factor in the formation of climatic features is the relief, characterized by a complex system of ravines and valleys of different height with a wide range of heights. Under the influence of the factors’ combination, there is a significant change in the radiation regime, as well as a modification of the air masses circulation and the formation of meso-climatic differences.

The circulation of the atmosphere in the territory under consideration is determined by the presence of the vast Russian Plain in the north, and in the south by the powerful mountain system of the Great Caucasus. The immediate and most important result of the above-mentioned factors is the slowing down and horizontal deformation of the fronts of the West European cyclones reaching the Great Caucasus. As a rule, the cold air coming to the Great Caucasus does not flow through it to the southern slope. Much more often there is a transshipment through the ridges of warm air, mainly from the southern slope to the north.

In general, anticyclones predominate in the region. Their repeatability is especially high in the autumn, when the number of days with them reaches 21-22 days per month. Mostly clear, sunny weather
and less often (in winter) is an overcast with drizzling precipitation, fog, ice and low clouds. The air masses brought in by anticyclones of the arctic, Atlantic and continental air form not only the mode and amount of precipitation, but also the air temperature, wind and atmospheric phenomena. With the arrival of the Arctic air in winter time, there are sharp and significant cooling periods, and in the summer time - the formation of dry weather with dry winds.

The most common cyclones are observed in January, June and July - up to 13-14 days per month. The weather conditions of the region are significantly influenced by the outputs of the southern, eastern and southeastern warm air masses. This cyclogenesis, as a rule, is accompanied by heavy rains and thunderstorms in the warm season and heavy precipitation in the cold. The yield of southern cyclones is observed most frequently in January, March and April; in summer, they are relatively rare. The southern cyclones in winter are accompanied by significant warming, precipitation, blizzards, and often icing. In the summer, thunderstorms and rainfall are associated with them, and in transitional seasons there are heavy rains.

The buildings and structures projected on the ASTRC Vedula can be divided into five altitudinal zones (see Table 1).

The climatic characteristics in the article are presented as averaged for the selected altitudinal zones. The climatic parameters values were determined as linearly dependent on the terrain height. The data of weather stations “Botlykh”, height 983 m and “Sulak V / g”, height 2927 m were selected as reference points.

Table 1. Average monthly and annual air temperature at various altitudes, °C

| The station name | Month  | Year |
|-----------------|--------|------|
|                 | I      | II   | III | IV  | V   | VI  | VII | VIII | IX  | X   | XI  | XII |
| Botlykh (983 m)| -1.4   | -0.1 | 3.5 | 10.5| 15.1| 18.1| 20.7| 20.2 | 16  | 10.3| 4.8 | 0.4 | 9.8 |
| Zone 1 (1000)  | -1.4   | -0.1 | 3.5 | 10.5| 15.1| 18.1| 20.7| 20.2 | 16  | 10.3| 4.8 | 0.4 | 9.8 |
| Zone 2 (1150)  | -2.0   | -0.8 | 2.7 | 9.5 | 14.1| 17.1| 19.8| 19.3 | 15.2| 9.6 | 4.2 | -0.2| 9.0 |
| Zone 3 (1450)  | -3.2   | -2.2 | 1.1 | 7.6 | 12.1| 15.2| 17.9| 17.6 | 13.6| 8.2 | 3.0 | -1.4| 7.4 |
| Zone 4 (1750)  | -4.5   | -3.7 | -0.5| 5.6 | 10.2| 13.4| 16.1| 15.9 | 12.0| 6.8 | 1.8 | -2.6| 5.8 |
| Zone 5 (2050)  | -5.7   | -5.1 | -2.1| 3.7 | 8.2 | 11.5| 14.2| 14.1 | 10.4| 5.3 | 0.2 | -3.7| 4.3 |
| Zone 6 (2350)  | -6.9   | -6.6 | -3.7| 1.8 | 6.3 | 9.6 | 12.6| 12.5 | 8.8 | 3.9 | -0.9| -4.9| 2.7 |
| Zone 7 (2650)  | -8.1   | -8.0 | -5.2| -0.1| 4.3 | 7.8 | 10.8| 10.7 | 7.3 | 2.6 | -2.3| -6.1| 1.2 |
| Zone 8 (2900)  | -9.5   | -9.3 | -6.9| -1.8| 2.4 | 5.9 | 8.9 | 9.0  | 5.7 | 1.2 | -3.5| -7.2| -0.4|
| Sulak, h/m (2927m) | -9.5  | -9.3 | -6.9| -1.9| 2.4 | 5.9 | 8.9 | 9.1  | 5.8 | 1.2 | -3.5| -7.2| -0.4|

Significant fluctuations in altitudes in combination with seasonal features of atmospheric circulation in the territory under discussion create a great variety in temperature conditions. The main indicators characterizing the thermal regime of air are the average monthly and annual temperatures, the absolute maximum and minimum, the onset dates of average daily air temperatures above and below the certain limits and the number of days with temperatures exceeding these limits.
With an increase in the absolute heights of the terrain, the air temperature decreases. The average annual temperature in the region decreases from 9.8 °C at an altitude of 983 m (Botlykh) to minus 0.4 °C at an altitude of 2927 m (Sulak, w / g) (see Table 1). Average monthly air temperatures also decrease with increasing altitude of the terrain.

The absolute minimum air temperature with a height, as a rule, decreases to minus 31.1 °C at an altitude of about 2927 m, and at an altitude of 983 m it is equal to minus 21.1 °C. It should be noted that the absolute minimum in the river valleys on the plateau is less than in the basins where the inversion phenomena are observed.

Usually the absolute minimum falls in January. At altitudes of about 1000 m, the absolute minimum has positive values for three summer months. At altitudes of 3000 m (MS “Sulak”) it is negative in all months of the year. Tables 2 and 3 present the characteristics of the study area temperature regime.

**Table 2. The average of the absolute minimum air temperatures at various altitudes, °C**

| The station name | I    | II   | III  | IV   | V    | VI   | VII  | VIII | IX   | X    | XI   | XII  |
|------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Botlykh (983 m)  | -12.6| -12.0| -9.4 | -1.8 | 4.1  | 8.3  | 12.0 | 10.8 | 5.3  | -1.5 | -6.4 | -10.9|
| Zone 1           | -12.6| -12.0| -9.4 | -1.8 | 4.1  | 8.3  | 12.0 | 10.8 | 5.3  | -1.5 | -6.4 | -10.9|
| Zone 2           | -13.3| -12.7| -10.1| -2.7 | 3.2  | 7.4  | 11.1 | 10.0 | 4.5  | -2.2 | -7.1 | -11.6|
| Zone 3           | -14.6| -14.2| -11.6| -4.5 | 1.4  | 5.6  | 9.3  | 8.4  | 3.0  | -3.6 | -8.5 | -13.0|
| Zone 4           | -15.9| -15.6| -13.1| -6.3 | -0.3 | 3.8  | 7.5  | 6.8  | 1.5  | -4.9 | -9.9 | -14.4|
| Zone 5           | -17.2| -17.1| -14.6| -8.1 | -2.0 | 2.0  | 5.7  | 5.1  | 0.0  | -6.3 | -11.3| -15.8|
| Zone 6           | -18.6| -18.6| -16.1| -9.9 | -3.8 | 0.3  | 3.9  | 3.5  | -1.5 | -7.7 | -12.7| -17.2|
| Zone 7           | -19.9| -20.1| -17.6| -11.7| -5.6 | -1.4 | 2.1  | 1.9  | -3.0 | -9.0 | -14.1| -18.6|
| Zone 8           | -21.3| -21.6| -19.2| -13.6| -7.4 | -3.2 | 0.3  | 0.2  | -4.5 | -10.4| -15.6| -20.0|
| Sulak, h/m (2927 m) | -21.3| -21.6| -19.2| -13.6| -7.4 | -3.2 | 0.3  | 0.2  | -4.5 | -10.4| -15.6| -20.0|

**Table 3. Average of the absolute maximums of air temperatures at various altitudes, °C**

| The station name | I    | II   | III  | IV   | V    | VI   | VII  | VIII | IX   | X    | XI   | XII  |
|------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Botlykh (983 m)  | 13.3 | 15.5 | 20.5 | 26.0 | 29.4 | 31.7 | 33.9 | 33.4 | 30.1 | 25.2 | 19.9 | 15.3 |
| Zone 1           | 13.3 | 15.5 | 20.5 | 26.0 | 29.4 | 31.7 | 33.9 | 33.4 | 30.1 | 25.2 | 19.9 | 15.3 |
| Zone 2           | 12.3 | 14.4 | 19.3 | 24.6 | 28.1 | 30.4 | 32.7 | 32.2 | 29.0 | 24.2 | 18.3 | 14.3 |
| Zone 3           | 10.4 | 12.2 | 16.8 | 21.9 | 25.4 | 27.9 | 30.3 | 29.9 | 26.8 | 22.0 | 16.2 | 12.4 |
| Zone 4           | 8.5  | 10.1 | 14.4 | 19.2 | 22.7 | 25.4 | 27.8 | 27.5 | 24.6 | 19.9 | 14.2 | 10.5 |
| Zone 5           | 6.6  | 7.9  | 11.9 | 16.5 | 20.0 | 22.8 | 25.4 | 25.2 | 22.3 | 17.8 | 12.1 | 8.6  |
| Zone 6           | 4.7  | 5.8  | 9.5  | 13.8 | 17.4 | 22.3 | 23.0 | 22.8 | 20.1 | 15.6 | 10.1 | 6.7  |
| Zone 7           | 2.8  | 3.6  | 7.0  | 11.1 | 14.7 | 17.7 | 20.6 | 20.5 | 17.9 | 13.6 | 8.3  | 4.9  |
| Zone 8           | 1.0  | 1.6  | 4.6  | 8.5  | 12.1 | 15.4 | 18.2 | 18.2 | 15.7 | 11.4 | 6.4  | 3.1  |
| Sulak, h/m (2927 m) | 1.0  | 1.6  | 4.6  | 8.5  | 12.1 | 15.4 | 18.2 | 18.2 | 15.7 | 11.4 | 6.4  | 3.1  |

In the territory under consideration, at the height of 983-2927 m the warm period lasts on the average from 177 to 301 days at the MS Sulak, high mountain and MS Botlykh, respectively. For the site at
altitudes of 980–1600 m, the warm period lasts from 267 to 301 days. The average duration of periods with air temperatures above 5 and 10 °C for the survey area according to the MS Sulak, the high mountain and MS Botlikh, respectively, varies with a decrease in height from 105 to 242 and from 41 to 191 days, respectively. For the survey site at the altitudes of 980–1600 m, the duration of the periods with air temperatures above 5 and 10 °C varies with a decrease in altitude from 204 to 242 and from 149 to 191 days, respectively. The temperature rises above 15 °C only at low altitudes. Thus, the average duration of periods with air temperatures above 15 °C at the MS “Botlikh” is 131 days.

On the study area there is a drop of the air temperature per day. According to the MS Itum-Kale (1415 m) for the period from 2013 to 2017, the maximum air temperature drop per day is 21.3 °C (see Table 4).

| Year | Maximum air temperature drop per day, degrees, C |
|------|-----------------------------------------------|
| 2013 | 19                                            |
| 2014 | 21                                            |
| 2015 | 18.8                                          |
| 2016 | 18.9                                          |
| 2017 | 21.3                                          |

**Summary**

The temperature regime of the ASTRC Veduchi was investigated. Significant fluctuations in altitudes in combination with the seasonal features of atmospheric circulation in the territory under consideration create a great variety in temperature conditions.

The study area is located at the altitudes of 983-2927 m and the warm period lasts on average from 177 days at the altitudes of 983 m and 301 days at the altitudes of 2927 m. The average length of the periods with air temperatures above 5 and 10 °C changes with a decrease in altitude from 105 to 242 and from 41 to 191 days respectively.

On the study area there is a drop of the air temperature per day. According to the MS Itum-Kale (1415 m) for the period from 2013 to 2017, the maximum air temperature drop per day is 21.3 °C.

**References**

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