

Geophysics

Modeling of Ozone Content Distribution in Lower Troposphere over the Territory of Georgia Using the Data of Satellite and Ground Observations

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ABSTRACT. The data of ozone content in the atmosphere are required for studying the climate change, ecological appraisals, etc. Frequently, the information of ozone content in troposphere above the large regions or continents is necessary. At present there are several satellite systems in the world for operational global checking the atmospheric parameters including ozone. Relatively low accuracy of satellite measurements can be considerably improved correcting them by using the data of ground-based measurements. Some results of modeling the average ozone content distribution in the 2.5- km layer of the atmosphere over the territory of Georgia according to the data of satellite and ground-based measurements in Tbilisi are given in the work. © 2015 Bull. Georg. Natl. Acad. Sci.

Key words: tropospheric ozone, satellite data.

Ozone is a very important parameter of the atmosphere. The data of this small constituent is required for studying the climate change [1], ecological appraisals [2], etc. In Georgia the atmospheric ozone examination (total ozone content, ozone vertical distribution and surface ozone concentration) started about 60 years ago [3]. Different scientific studies of atmospheric ozone (long-term) variations in the total and surface ozone content continued for many years and their connection with human health, as well as photochemical smog in the atmosphere of Tbilisi and its influence on the human health (quasi-biennial variations of the stratosphere ozone and solar activity,

the evaluation of the influence of variations of the total ozone content on the changeability of the regime of biologically active ultraviolet solar radiation and, etc.) were investigated [1-6]. In recent years the investigations of the surface ozone concentrations are conducted only in Tbilisi and Ruispiri (near Telavi, East Georgia) [2, 5, 6].

The data of ozone content in troposphere above the large regions or continents is important for some investigations. Ground-based study of these atmospheric parameters over the large area is a difficult and expensive procedure. Furthermore, large changes in the environment require rapid renovation of param-

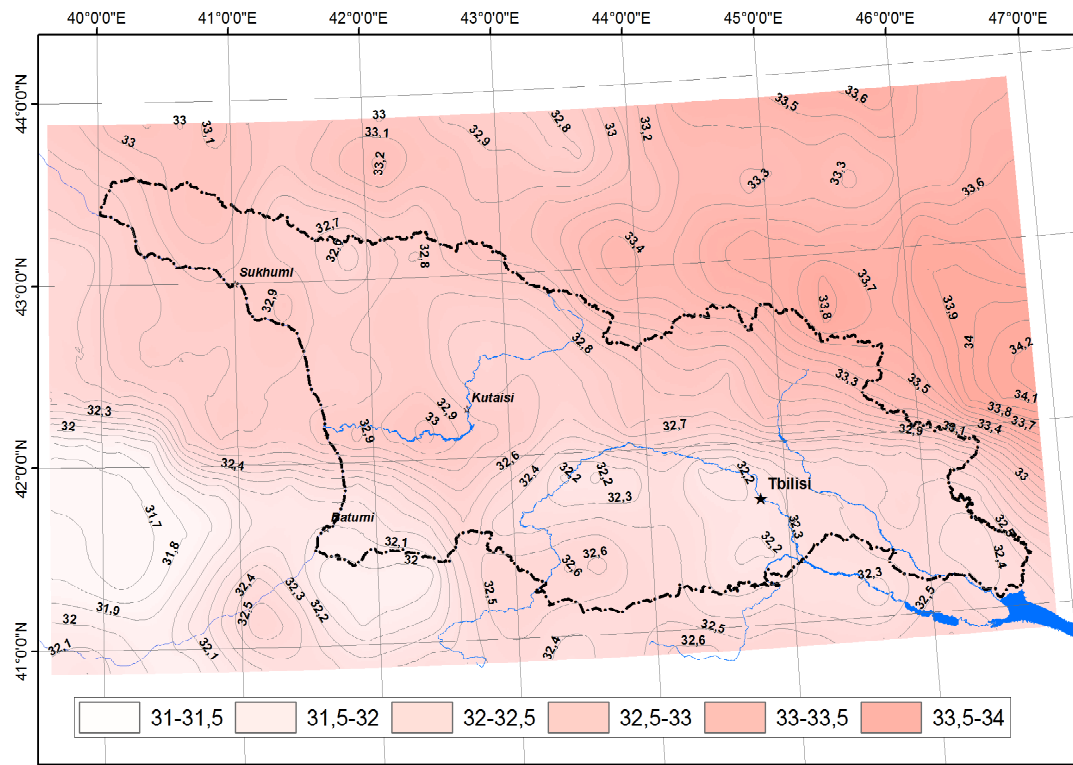


Fig. 1. Mean annual tropospheric ozone concentration distribution over territory of Georgia (mcg/m³).

eter measurement and creation of the dense network of the ground stations of observations.

At present there are several satellite systems in the world for operational global checking of the atmospheric properties. These satellites are equipped with microwave and optical instruments for measuring different atmospheric parameters including ozone [7-11]. Relatively low accuracy of satellite measurements can be considerably improved by correction of the data of ground-based measurements.

The methodology of determination of ozone content distribution in lower troposphere above the territory of Georgia according to the data of satellite [7-11] and ground-based measurements in Tbilisi [2, 5] are given in detail in [12, 13].

Some new results of modeling the daily average ozone content distributions in 2.5- km layer of the atmosphere over the territory of Georgia are given below. In the work the data of the satellite and ground-based measurements of tropospheric ozone of 2009-2011 years are used [2, 12, 13]. The results of modeling of the ozone content distribution in lower troposphere

over the territory of Georgia are represented in Figs. 1 and 2.

The map of distribution of the ozone of concentrations in lower 2.5 km atmosphere layer over the territory of Georgia and adjacent countries (a darker tone corresponds to higher values of ozone concentration) is presented in Fig 1. As follows from the figure, the tendency of ozone content growth in the troposphere from the south to the north direction is observed.

It should be noted that a similar tendency is revealed also for the total ozone content both above the territory of Georgia and above the Black Sea - Caucasian - Central-Asiatic region [1]. In this case the values of the latitudinal changeability of the ozone content are close to each other: approximately 10% of the tropospheric ozone concentration (from 31 to 34 mcg/m³, Fig. 1) and 13 % of the total ozone content (from 310 to 350 Dobson Unit [1]).

The map of the changeability of mean annual tropospheric ozone concentration in lower 2.5 km atmosphere layer over the territory of Georgia and

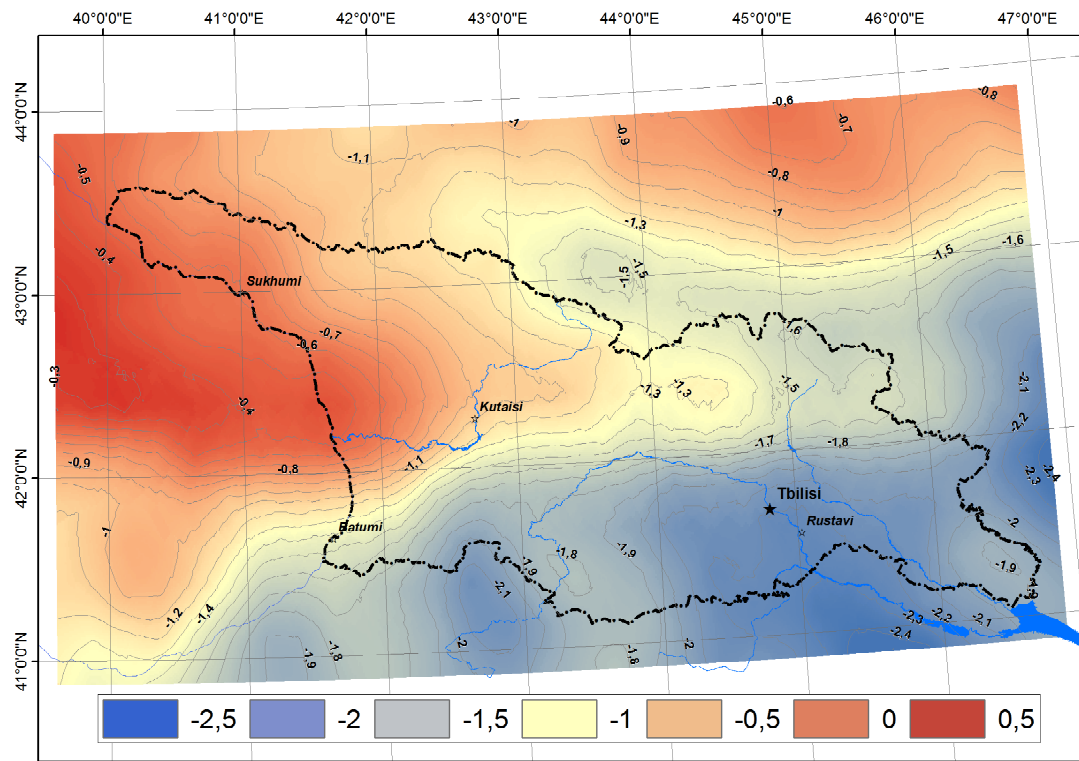


Fig. 2. Changeability of mean annual tropospheric ozone concentration over the territory of Georgia (mcg/m³/year)

adjacent countries (a dark-blue tone corresponds to higher values of the negative changeability of ozone concentration; a brown darker tone corresponds to low values of the negative or positive changeability of ozone concentration) is presented in Fig 2.

As follows from Fig. 2, the tendency of a decrease of ozone content changeability in the troposphere from the south to the north direction is observed.

Thus, for Tbilisi the tendency of the decrease of the tropospheric ozone content in 2009-2011 yr. is composed by -2.1 mcg/m³/year (Fig. 2). It is interest-

ing to note that this tendency for Tbilisi was preserved also in 2012 and 2013. Thus, in 2012 the mean annual daily surface ozone concentration in Tbilisi decreased by 2.2 mcg/m³ in comparison with 2011[14]. Ozone concentration in 2013 decreased even more - 11.3 mcg/m³.

In conclusion let us note that the modeling of the seasonal and monthly distribution of the tropospheric ozone content above the territory of Georgia is provided. These models will be used for solving different scientific and applied problems in the field of physics of the atmosphere (climate change, questions of ecology, medical climatology, etc.).

გეოფიზიკა

ოზონის შემცველობის განაწილების მოდელირება ქვედა ტროპოსფეროში საქართველოს ტერიტორიაზე სატელიტური და მიწისპირა მონაცემების გამოყენებით

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ატმოსფეროში ოზონის შემცველობის მონაცემები საჭიროა ამინდის ცვლილებების შესწავლის, ეკოლოგიური შეფასებებისათვის და ა.შ. ხშირ შემთხვევებში აუცილებელია ინფორმაცია ტროპოსფეროში ოზონის შემცველობის შესახებ დიდი რეგიონების ან კონტინენტების ზემოთ დღეისათვის მსოფლიოში არსებობს ატმოსფერული პარამეტრების რამდენიმე თანამგზავრული სისტემა, მათ შორის, ოზონის ოპერატიული გლობალური შემოწმებისათვის. სატელიტური გაზომვების შედარებით დაბალი სიზუსტე შეიძლება მნიშვნელოვნად გაუმჯობესდეს ხმელეთზე გაზომვების მონაცემებით წინამდებარე ნაშრომში მოცემულია გარკვეული შედეგები საქართველოს ტერიტორიის ზემოთ ატმოსფეროს 2,5 კმ. ფენაში ოზონის საშუალო შემცველობის შესახებ, სატელიტური მონაცემებისა და თბილისის სახმელეთო გაზომვების მიხედვით.

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