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Features of the spatial distribution of gaseous impurities in the atmosphere of the South-Eastern coast of Lake Baikal by route measurements in the summer period 2018-2019

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ABSTRACT. The paper presents the results of route measurements of concentrations of sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2) in the atmosphere of the coastal zone of Lake Baikal in summer by Kultuk-Turka route in 2018 and along the Gremyachinsk-Monakhovo route in 2019. In summer period 2018 along the entire route, increased concentrations of SO_2, CO, NO_2 were observed in Noviy Enkhaluk with averaged values of 7.4 μg/m^3, 2.8 mg/m^3 and 11 μg/m^3, respectively. Analysis of the obtained data of measurements of small gas impurities on the Gremyachinsk-Monakhovo route shows that the content of sulfur dioxide in the Barguzin Bay is 3 times higher than the data obtained in 2018 on the Kultuk-Turka route. The high level of SO_2 is due to the current weather situation associated with fires in large forest areas.

Keywords: atmosphere; concentration; route measurements; Lake Baikal

With the development of tourist activities in the summer, the negative anthropogenic influence on the atmosphere and water environment of the Baikal region increases. In this regard, it is important to find out how these negative processes will affect the content of greenhouse gases in the ground level (Panchenko et al., 2013; Kravtsova et al., 2014; Timoshkin et al., 2015; Zayakhanov et al., 2019).

Kultuk-Turka route (2018). In August 15-21, 2018, route measurements of concentrations of sulfur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide in the atmosphere of the coastal zone of Lake Baikal were carried out near industrial centers (Baikal, Babushkin, Kultuk, Vydrino, Tankhoy, Boyarsk, Enkhaluk, Gremyachinsk, Turka). Air sampling was carried out at a height of 2 m from the ground level using the carbon monoxide gas analyzer "MGL-19M", nitrogen oxide gas analyzer P310A, carbon dioxide gas analyzer "OPTOGAZ-500.4" and sulfur dioxide gas analyzer C-310A.

Measurements of small gas impurities in the surface atmosphere revealed a certain contrast of variations in the concentrations of sulfur dioxide, nitrogen dioxide, and carbon monoxide depending on the direction and speed of the wind, as well as on the influence of local local emission sources. Weather conditions in the village Kultuk, Baikalsk, despite the developed transport system (highway P258, Federal highway A333 (Tunkinsky tract), TRANS-Siberian highway), it was not possible to record the expected high anthropogenic values of gas impurities. During the measurement period, the weather was overcast with light precipitation, and the East wind prevailed.

Along the route the increased concentrations of SO_2, CO, NO_2 were observed in the village Noviy Enkhaluk with averaged values of 7.4 μg/m^3, 2.8 mg/m^3 and 11 μg/m^3, respectively. Anthropogenic affect on the atmosphere in the tourist recreation area of Noviy Enkhaluk is primarily associated with the influence of smoke from fires and car exhausts.

The concentration of sulfur dioxide in the remaining observation points was small and varied mainly from 3.2 to 4.7 μg/m^3. Over the entire period of route measurements, the average concentrations of nitrogen dioxide NO_2 were low and ranged from 6 to 11 μg/m^3.

Increased concentrations of carbon monoxide CO were observed in the coastal zone of Babushkin and the Tankhoi that reached average values of 2.2 mg/m^3 and 1.5 mg/m^3, respectively. The high level of carbon monoxide in these points is probably due to the influence of a local source of atmospheric pollution – a

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smoking landfill located in the forest along the M55 highway near train station Klyuyevka.

Gremyachinsk-Monakhovo route (2019). In the coastal zone of the Chivyrkuy Bay, measurements were carried out in the village Monakhovo near the pier and in the area "Glinka" (the beginning of the Svyatoy Nos Peninsula) at the intersection of sand and gravel roads. On the pier in the village Monakhovo a repair work on paving slabs carried out but we did not record high concentrations of small gas impurities. It is worth noting that on the night before the measurements, a strong storm with rain passed in the study area and most likely this contributed to the leaching of impurities from the atmosphere to a greater extent. The average concentrations of SO_2, NO, NO_2 and CO_2 were 9.6 μg/m^3, 2 μg/m^3, 3 μg/m^3 and 409 ppm, respectively. Measurements in the area "Glinka" were carried out in sunny weather with a gusty wind. There were also no elevated concentrations of small gas impurities.

Increased concentration of sulfur dioxide was observed in 5 km from the village Maximikha to the North-West near the boarding house "Rovesnik". In clear and cloudless weather with calm conditions, the highest SO_2 value is recorded here-30 μg/m^3. In addition, high values of sulfur dioxide were observed in the coastal zone of sandy beaches in Goryachinsk and Gremyachinsk, which are most strongly affected by anthropogenic impact from tourist complexes located along the coast and a large concentration of vacationing tourists.

Over the entire period of route measurements, the average concentrations of nitrogen dioxide NO_2 were low and ranged from 3 to 11 μg/m^3.

Analysis of the obtained data of measurements of small gas impurities along the entire route shows that the content of sulfur dioxide in the Barguzin Bay is 3 times higher than the data obtained in 2018 on the Kultuk-Turk route. The high level of SO_2 is due to the current weather situation associated with fires in large forest areas. According to MODIS satellite observations and (http://fires.kosmosnimki.ru) in the summer of 2019 large-scale forest fires were observed in the Irkutsk region, Krasnoyarsk territory and Yakutia, as a result of smog from forest fires since the end of July, the entire water area and the coast of the Lake Baikal were covered.

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