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Potentional toxic risk from the nano- and microparticles in the atmospheric suspension of Russky Island (Vladivostok)

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ABSTRACT

The results of the study of particles in atmospheric suspensions contained in the snow cover of the Russky Island (Vladivostok), including the territory of the campus of Far Eastern Federal University (2014/2015 winter season), are presented in the paper. The increase in the concentration of suspended particles sized under 10 µm is registered in different areas of the island: at the campus of Far Eastern Federal University, in Canal settlement and near the Primorsky Aquarium. Particles sized under 1 µm were found at all five sampling stations in concentrations from 3.3 to 9.3%. This is due to the increase of anthropogenic pressure on the Russky Island which is an unfavorable prognostic factor.

Key words: atmosphere, suspension, microparticles, Russky island, Far Eastern Federal University campus

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INTRODUCTION

Vladivostok is the actual capital of the Far Eastern Federal District of Russia. The city is noteworthy due to its special location on the Muravyov-Amursky Peninsula reaching far into the sea, as well as due to its size (the largest city in the Far Eastern Federal District) and a small number of industrial enterprises.

Russky Island as a district of Vladivostok is an ecologically safe area; there are no large industrial enterprises polluting the environment here. The large economical entities located on the island are settlements Canal, Podnozhye and Ekipazhny, Far Eastern Federal University (FEFU) campus, Far Eastern fire and rescue Academy; a small combined heat power plant working on gas, and a municipal solid waste landfill.

According to the census the population of the island in 2010 constituted 5360 people. In 2012, in preparation for the APEC summit, a campus of Far Eastern Federal University (FEFU) was build – the largest university in the Far East and Siberia (Fig. 1.).

At the moment, over 30,000 students study in FEFU, several thousands of teachers and support staff work here, which makes the total number of campus population (permanent and transient combined) comparable with the population of a small town.

We have been studying the atmospheric pollution of the Russky Island for several years [1, 2]. The data on snow pollution at new sampling stations providing more detailed information on atmospheric pollution of the island is presented in this paper.

Figure 1. FEFU campus on Russky Island. © OpenStreetMap contributors

MATERIALS AND METHODS

The snow samples were collected at five sampling stations on Russky Island in the snowfall during the winter 2014/2015 (Figure 2). The sampling stations feature different environmental conditions in accordance with our method [1, 2].

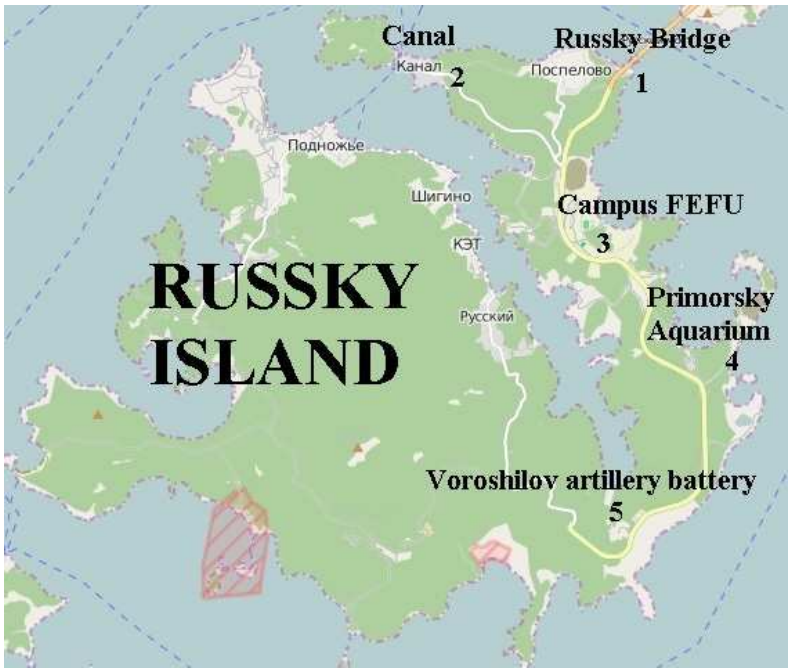

Figure 2. A schematic map of snow sampling stations on the territory of Russky Island (sampling stations described in detail in Table 1). © OpenStreetMap contributors

The sampling sites were chosen in accordance with the residence or presence of a large number of people (the settlement and campus), as well as zones with high anthropogenic pressure (the bridge with great transport flow). The rest of the Russky Island (Voroshilov battery and the Aquarium) is regarded as a clean suburban area without anthropogenic influence.

Studies were conducted with use of the equipment of the "Interdepartmental Center of Analytical Control of a State of Environment" of the Far Eastern Federal University.

Table 1Snow sampling stations on Russky Island

Sampling station	Description of sampling stations
1. Bridge	A large road bridge linking Russky Island and mainland. The samples were taken near the traffic circle, at a distance of 10 m from the road.
2. Canal	Canal settlement. The samples were taken across a bus stop at 10 m distance from the road.
3. Campus	FEFU campus. The samples were taken on campus territory, close to the main checkpoint, at a distance of 10 m from the road and the bus stop.
4. Aquarium	Primorsky Aquarium. The samples were taken near the checkpoint.
5. Voroshilov artillery battery	Voroshilov artillery battery. This is a historical Museum in the clean park area. The samples were taken near the checkpoint.

RESULTS AND DISCUSSION

The results of particle size analysis of snow samples taken during the winter season 2014/2015 are presented in Table 2 and Figures 2-4.

Table 2 The distribution of particle fractions in the snow at sampling stations on Russky Island

Fraction, ∅, µm	Bridge	Canal	Campus	Aquarium	Battery
under 1	8.3	3.3	4.5	5.5	9.3
1–10		41.9	44.5	40.1	
10–50	25.5	52.5	23.6	13.8	56.8
50–100	13.1	0.8			6.9
00–400	11		2.4		7.2
400–700	27.1		22.6	11.1	2.9
over 700	15.2	1.5	2.4	29.5	16.9
Average arithmetic diameter, µm	321.4	21.8	152.68	337.6	207.83
Mode, µm	16.36	18.33	520.61	826.95	16.45

According to many researchers particles $PM_{0.1}$, PM_1 and PM_{10} (1 and 2 size classes according to our classification) are the most dangerous to human health. They were found in 2014/2015 season in the samples from stations Canal, FEFU campus and Aquarium (Figures 3 and 4).

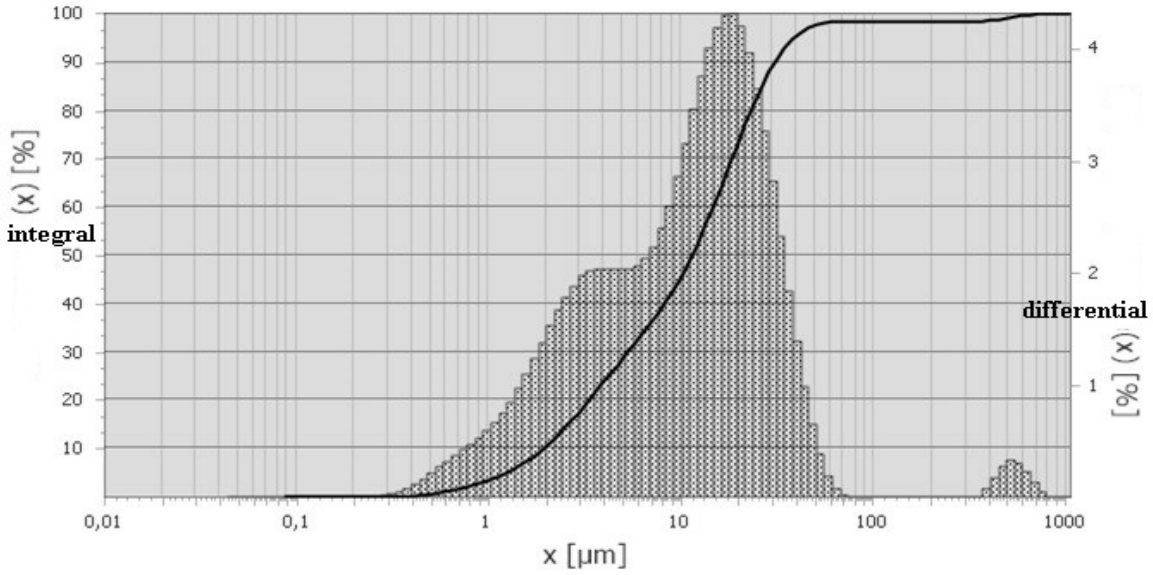

Figure 3. Fraction composition of atmospheric suspension by the results of the analysis of snow cover pollution in the vicinity of Canal settlement

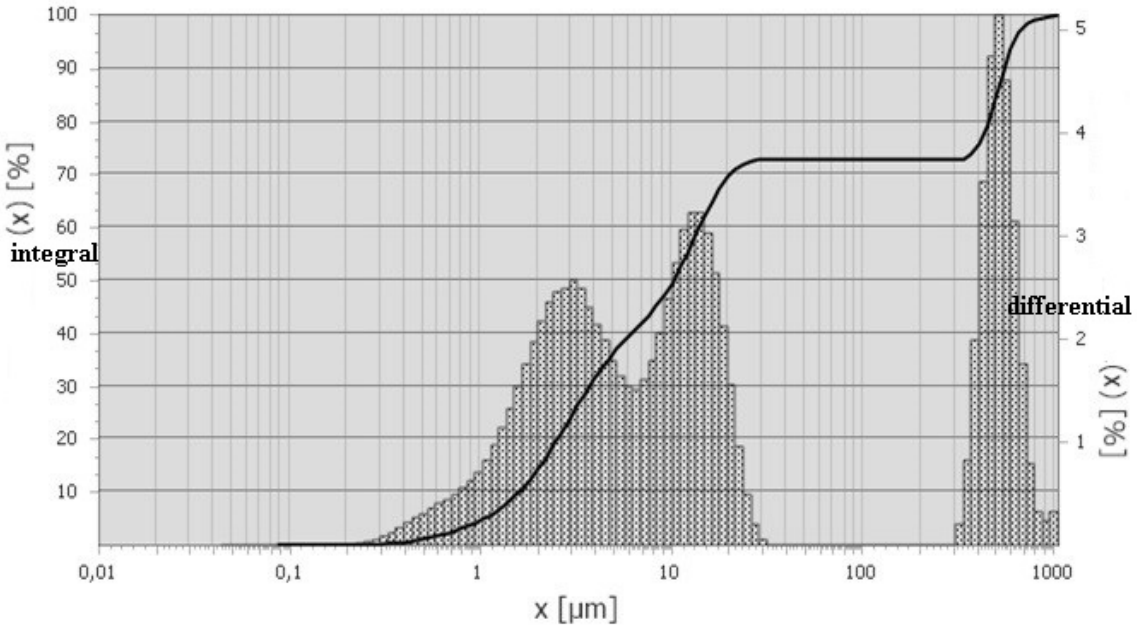

Figure 4. Fraction composition of atmospheric suspension by the results of the analysis of snow cover pollution in the vicinity of FEFU campus

We have to acknowledge that the concentration of particles under 10 µm in the air near Canal settlement and FEFU campus has increased.

CONCLUSION

It should be noted that the academic activities have started in the campus of Far Eastern Federal University in September 2013, and consequently, the traffic flow has increased greatly. Over three years of data collection [1, 2] we have observed the growth of the content of nano- and micro-sized particles in air suspensions in other areas of the island as well, where, due to objective reasons (for example, the construction of the Aquarium), the number of motor vehicles has increased.

During the season 2014/2015 we have found particles sized under less than 1 µm in all areas of the island in quantities from 3.3 to 9.3%. Previously [1] we found particles of this size fraction only near road junctions (the bridge and Canal settlement). These particles were produced by car exhausts (soot and metal-containing particles).

This may indicate a build-up of anthropogenic pressure even in the areas located far from industrial enterprises and large road junctions (e.g., the Voroshilov artillery battery).

Summing up the results of long-term observations of the particle size composition of the Russky Island atmosphere, it should be noted that a gradual increase of anthropogenic pressure, including the increase in the flow of motor vehicles, adds to the nano- and micro-sized air pollution.

An important result of this work is a proof of the fact that changes in the sizes of fractions happen extremely quickly with the increase of man-made pressure. For example, in our previous study (seasons 2011/2012/2013) we found particles sized under 1 µm only in some areas of the island; while during the 2014/2015 season they were found in all areas. These facts should attract attention.

FEFU campus and Canal settlement inhabited by over 30,000 people in total are important ecological and hygienic objects for observation. The Aquarium, where the particles sized under 10 µm were found (up to 45.6%), apparently is experiencing a temporary man-made pressure associated with the construction.

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REFERENCES

[1] KS Golokhvast, PA Nikiforov, VV Chaika. Atmospheric suspensions of Russky Island, *Proceedings of SPIE*, **2014**, 9292, 929232.

[2] KS Golokhvast, PA Nikiforov, VI Petukhov, VV Chayka. Atmospheric suspensions of russky island (Vladivostok) during the 3-year supervision (2011-2013), *Human Ecology*, **2014**, 11, 9-12.