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The light pollution from airports

Airports are considered as the sources of light pollution and the possible spread of the negative factors of influence is shown. The human health effects as well as effects on wildlife are considered.

Life of organisms takes place under a variety of environmental factors, which form specific media environment made of abiotic and biotic components. Those having material nature include air, water, soil and other easily perceivable components. However, living creatures are also located within a certain physical environment, which might be separated into:

- audioscape – combination of sounds and noise components;
- visioscape – combination of visual fields, forming immediate scenery for organisms and including both favourable components and visual pollution;
- photoscape – level of illumination from natural and artificial sources, providing necessary visual information and creating light pollution;
- electroscope and magnetoscape – parameters of electromagnetic fields of natural and manmade origin, which are the least perceived, yet effective;
- radioscape – level of inozing radiation, which raises problems when living organisms get into the impact area of the levels above average.

All these components are still under investigation in terms of the "dose-effect" ratios establishment and formulation of management approaches to limit negative consequences for living organisms, as well as setting some threshold values for the protection and avoidance of disturbance.

Light or visible light is electromagnetic radiation within the portion of the electromagnetic spectrum that can be perceived by the eye. All living organisms are adapted to certain parameters of the photoscape, which affects their behaviour and physiology. The possible deviations from the typical levels of illumination are quite noticeable for organisms, since light coming from the Sun is one of the most stable attributes of environment. However, human activity is able to produce considerable modifications into what is perceived as usual and normal. This is especially seen in the case of light pollution, which is a product of civilization development.

Generally speaking, light pollution is the presence of anthropogenic and artificial light in the night environment. It is exacerbated by excessive, misdirected or obtrusive use of light, but even carefully used light fundamentally alters natural conditions. As a by-product of urbanization, it is said to be connected with health effects, ecosystems disruption and further formation of visual pollution.

Forms of light pollution are quite different and in case of airports include almost all of them:

- light outgrowth occurs when unwanted light enters one's property, which is often the case for the airports inside the urban areas or close to them;

- over-illumination is the lighting intensity higher than appropriate for the airport activity, which overexposes area and population around the airport to high levels of light;
- glare,is difficulty of seeing in the presence of bright light, is also the case for airports, as both airfield and terminals illumination bedazzle with a strong direct or reflected light;
- eye clutter is also formed in airports from numerous information signs and advertising boards, it violates perception of information by humans and distorts visual signals typically “read” by wildlife;
- sky glow is the diffuse luminance of the night sky, apart from discrete light sources such as the Moon and visible individual stars and it is usual marker of any airport, becoming stronger the bigger an airport is.

For the assessment of light pollution from the facilities like airports some specific parameters are necessary, as they must characterize the intensity of excessive light and overall effect of pollution phenomenon, but not the light itself. One of the important parameters of such kind is sky luminance and sky glow.

For the purpose of the research the luminance at the territory of the Igor Sikorsky Kyiv International Airport (Zhuliany) was measured with the standard luxmeter at the distances 50 m, 100 m, 500 m from the limits of the airport area in the direction towards residential buildings and residual natural plant associations.

The measurements were conducted after the complete sunset at the same time in all points in three subsequent days in October and January 2021. The days were chosen so, that the atmospheric conditions were similar, in particular, sky clearance and condition of the underlying surface (dry or wet). The direct exposure to street lights was avoided, so only the scattered light pollution was accounted.

The phase of the moon and the time of the moonrise were also accounted. These indicators are necessary to form the benchmark level for the differentiation between normal photoscape and light pollution. Thus, at nights with the full moon, the norm of the light level is 0.2 Lux and this is an acceptable maximal level of night luminance, used for analysis.

The results demonstrated considerable level of luminance far above the normal levels ranging from 54 to 108.5 Lux. In general, the results of autumn and winter measurements are similar, no sharp contrasts are observed. The general state of the sky in the airport area was far from the complete darkness by Bortle scale and could be ranked as 7 or 8 class, when the sky is brightly lit and no astronomic attributes of the sky are visible, except the Moon.

The light pollution is typical for cities, however, airports are noticeable even on the urban photoscape. There is a range of web-based applications, which enable visualizing the level of light pollution around the world. Among those the VIIRS DNB was the first satellite instrument intentionally designed to image human lights on the worldwide scale. This web application allows you to examine changes in nighttime light emissions (nearly) worldwide, from 1992 up until last month.

The data obtained for Kyiv clearly demonstrate the increased radiance from the Igor Sikorsky Kyiv International Airport (Fig.1). The trend for the area is towards growing pollution levels, even though the discrete levels are fluctuating (Fig.2).

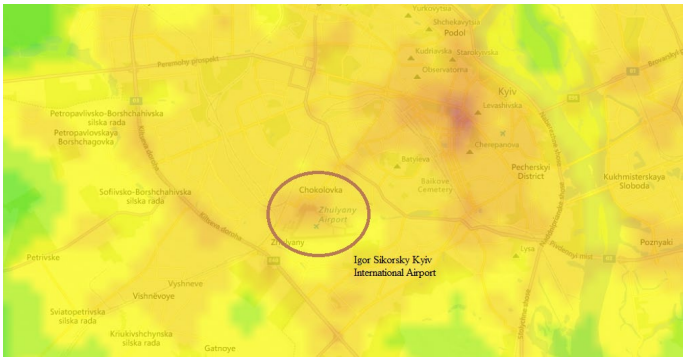

Fig. 1 – Level of light pollution from the city of Kyiv

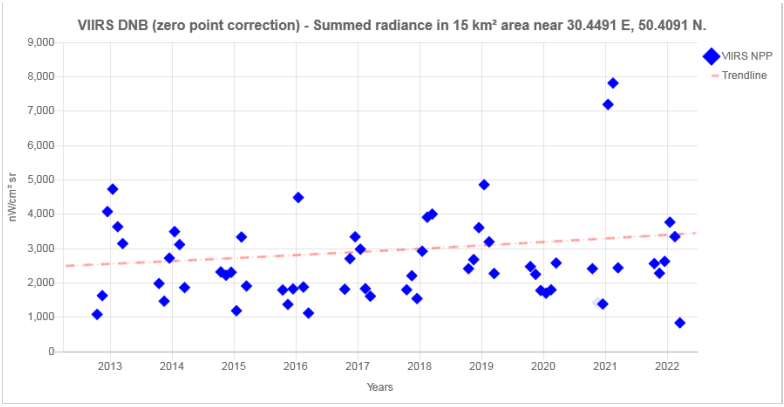

Fig. 2 – Light trends chart for the Zhulyany airport

Conclusions. The level of light pollution, created by airports is turning into a powerful environmental factor with upward trend. Under such conditions the health impacts and effects on the living cycles of biota will grow steadily raising concerns about living systems resilience.

References

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