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FOR THE METHODOLOGY OF ENVIRONMENTAL MONITORING AND EXPERTISE IN ENVIRONMENTAL POLLUTION

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Summary: *Environmental pollution is called the appearance in it of new, uncharacteristic agents that have a negative impact on its processes and on the vital activity of organisms associated with it. Air pollution is one of the most dangerous in the biosphere, since the atmospheric air, due to its low density, is capable of dispersing toxic substances over long distances. The growth of atmospheric pollution in the last century is the result of a complex of environmental factors. First of all, these are factors of natural origin. Among them, the leading role is played by volcanic activity, vital activity of organisms, wind erosion, precipitation and fires. The factors of technogenic origin include the development of energy and metallurgy, transport, burning of fossil fuels, production and use of fertilizers, extraction and processing of oil and gas, chemical synthesis, radioactive emissions, as well as industrial accidents and disasters. The presented data are related to the methodologies of monitoring and disaster risk reduction and is the main purpose of the article.*

Key Words: *Sendai Framework; chemical, physical, mechanical and biological pollutants; vibration; light pollution; thermal pollution; electromagnetic pollution; Nuclear pollution; mechanical air pollutants; aerosols; biological air pollutants;*

Introduction. The consistency of the Sendai Framework and the Sustainable Development Goals targets creates conditions for the development of minimum standards and metadata for the collection of disaster-related data for disaster risk reduction. As is known, on 2 February 2017, by adopting resolution A / RES / 71/276, the United Nations General Assembly approved the report of the Open-ended Intergovernmental Working Group of Experts on Indicators and Vocabulary for Disaster Risk Reduction (IEWG) (A / 71/644). This work is presented to facilitate the development of a methodology for quantifying indicators and processing statistics for the Sendai Framework [1].

About methodologies. The term "pollutant" means any material agent of chemical, physical or biological nature that enters the environment as a result of natural or man-made processes and has a negative impact on it. In the monitoring system, it is accepted to divide all environmental pollutants, depending on their nature, into 4 groups: chemical, physical, mechanical and biological. Chemical pollutants in the air are various elements and substances that have a negative effect on atmospheric processes and on the vital activity of organisms associated with it. For example, toxic gases - NH_3, CO, SO_2, H_2S, etc.

Physical air pollutants mean various energetic phenomena and processes that change the basic physical constant atmospheres and have a negative impact on the vital activity of organisms. For example, noise, vibration, electromagnetic radiation, etc.

Biological air pollutants are pathogenic (pathogenic) organisms that can be transmitted through the atmospheric air to humans, animals and plants and cause their mass diseases. For example, pathogens of influenza, acute respiratory infections, tuberculosis, etc. The most important chemical pollutants of the atmosphere include various gases: Carbon dioxide CO_2, Carbon monoxide CO, Methane CH_4, hydrocarbons CxHx, Sulfur oxide IV SO_2, Hydrogen sulfide H_2S, Nitric oxide II NO, Nitric oxide IV NO_2, Ozone O_3, Chlorine Cl_2, Hydrogen fluoride and other hydrogen halides HF, HCl, HBr, HI. The group of chemical air pollutants also includes some metals: Mercury, Lead, Manganese, Copper, Zinc, Nickel, Cadmium - particles of which are capable of dispersing through the air. The most important forms of physical pollution of the atmosphere include: Noise pollution - excess of the natural and established noise level, i.e. the pressure of

the sound wave. Living organisms have physiological limits for their sensitivity to noise. At a high level of noise in a person, the function of the auditory analyzer is disrupted, irritability occurs, sleep disturbances, nervous diseases develop, and the biochemical composition of the blood changes. Prolonged exposure to noise levels of 90-100 dB can lead to complete loss of hearing. Noise pollution has many natural and man-made sources. For example, road transport increases the natural noise level by up to 85 dB; railway transport up to 100 dB; air transport up to 110 dB; heavy industry enterprises 120 dB; gas turbine units 140 dB, etc. Vibration is a complex oscillatory process resulting from the transfer of alternating pressure (energy fluctuations) from any mechanical source. Vibration, like noise, is measured in decibels (dB).

Numerous natural and man-made processes can be a source of vibration - earthquakes, volcanic eruptions, transport, industrial activities, etc. Long-term exposure to vibration on the human or animal organism causes vibration disease. At the same time, irritability, sleep disturbance, memory disturbance, arrhythmia develop.

Vibration is also extremely dangerous for buildings and various mechanisms. Light pollution is a violation of natural illumination of the area as a result of exposure to artificial light sources. Light pollution is most typical for large settlements, as well as for areas with a developed industrial and transport network (road and railways, airports, etc.). Long-term light pollution can lead to serious disruption of the vital processes of plants and animals - behavior, sleep, photosynthesis, etc. Ultraviolet radiation is a type of light pollution that occurs due to an increase in the level of ultraviolet rays in the environment. UV rays have a wavelength in the range of 400 to 10nm.

The sun is a natural source of ultraviolet radiation in the atmosphere, and various installations used in industry, medicine, and everyday life are man-made. Compared to infrared and visible rays, UV rays have the greatest amount of energy, which makes them dangerous for living organisms. Particularly dangerous is short-wave (hard) ultraviolet light, which, with short-term exposure, causes burns of the surface integuments, and with longer exposure, serious tissue damage, destruction of the genetic material of cells and the death of organisms. Hard ultraviolet light is almost completely absorbed by the ozone screen of the atmosphere. In addition to ozone, water and any mechanical shelter are natural protection against UV rays.

Thermal pollution is a violation of the natural temperature regime of the area due to the influx of streams of heated or cooled air. Thermal pollution of the atmosphere can be primary when heat flows from various natural or man-made processes directly change the air temperature. The negative consequences of thermal pollution include a change in the migration flows of elements in the air, a violation of the physiological rhythms of plants and animals, damage to mechanisms, etc.

Electromagnetic pollution is a violation of the electromagnetic properties of the environment. The electromagnetic background of the environment can change due to natural processes (for example, with a change in solar activity), as well as technogenic reasons. Any electrical appliance, from household equipment to powerful industrial installations, can become a source of electromagnetic rays. High-voltage power lines, television and radio towers, high-voltage generators, and military installations make a special contribution to the violation of the electromagnetic background.

The norms of the electromagnetic flux, determined through the power of its field, are: for power lines up to 30mW/cm2, military facilities up to 10mW / cm2, airport communication lines up to 1mW / cm2, for residential premises less than 1mW/cm2. With prolonged exposure to electromagnetic fields, a person develops chronic fatigue, headaches, memory impairment, and drowsiness. Electromagnetic rays lead to changes in the fine cellular and molecular structures of the body, which can cause various diseases. Electromagnetic pollution is associated with a malfunction of electronic systems, interference in the transmission of information.

Radioactive contamination - excess of the natural level of radioactive substances in the natural environment. The radioactive substance is represented by unstable isotopes of individual elements, which act as a source of hard ionizing radiation. The most common radioisotopes include Strontium-90, Cesium-137, Cerium-141, Iodine-131, Ruthenium-106, Plutonium-239, and a number of others. The source of radioisotopes entering the air is man-made processes - the development and enrichment of radioactive ores, testing of nuclear weapons, accidents at nuclear power plants, leaks from burial sites of radio waste, etc.

The group of mechanical atmospheric pollutants includes dust and aerosols. There are the following types of dust: 1.Fine dust - particle size is less than 0.001 microns. Able to stay in the air for a long time.

2.Semi-fine dust - particle size is from 0.001 to 2.5 microns. Has a higher rate of settling on substrates compared to fine dust. 3. Coarse dust - represented by heavy, inactive particles with a diameter of more than 2.5 microns. It quickly settles and becomes the cause of secondary pollution of the environment. Aerosols are represented by water particles suspended in the air. The average size of atmospheric aerosols is from 0.001 to 10 microns. Numerous natural and man-made processes act as a source of dust and aerosols entering the atmosphere. These are dust storms, volcanic eruptions, sea spray, fires, mining, agricultural and industrial activities, transport, household waste, etc. Dust and aerosols can seriously disrupt a number of important atmospheric processes. These include an increase in the albedo (ie, reflectivity) of the atmosphere, resulting in less solar radiation reaching the surface of the earth and ocean; reduced visibility of the atmosphere; secondary pollution due to subsidence of surface substrates; violation of the processes of photosynthesis and respiration of organisms; damage to mechanisms; reduction of aesthetic parameters of the environment, etc.

The group of biological air pollutants includes various pathogenic organisms. By etiology, they are divided into: causative agents of viral diseases - influenza, smallpox; causative agents of diseases of a bacterial nature - tonsillitis, acute respiratory infections, tuberculosis; pathogens and vectors of diseases of a eukaryotic nature - mosquitoes, horseflies, midges, biting midges, gadflies, allergenic plant pollen (ragweed), etc.

Modern methods for assessing the ecological state of the air environment are subdivided into remote (aerospace) and ground-based. According to the scope of research, global (biospheric), national, regional and local monitoring of the atmosphere are distinguished.

Local monitoring of the air environment can be divided into the following areas: monitoring of the most important climatic elements and phenomena; monitoring of the state of the surface air layer, carried out by bioindication methods; monitoring of the state of the surface air layer, carried out by physicochemical methods; mathematical modeling and forecasting of the state of the most important components of the air environment. Monitoring of soil and land pollution. Monitoring of soils and lands is aimed at assessing their condition as the most important resource of the environment and identifying their qualitative and quantitative pollution.

All the most important soil pollutants, depending on their nature, can be divided into chemical, physical, mechanical and biological. Chemical elements according to the degree of danger to soils are divided into three classes: 1. Highly hazardous - As, Cd, Hg, Se, Pb, Zn, F; 2. Moderately hazardous - B, Co, Ni, Mo, Cu, Sb, Cr; 3.Low hazardous - Ba, V, W, Be, Mn, Sr. In soils, gross and mobile forms of chemical elements and their compounds are distinguished. Gross forms are in the composition of chemical compounds and the organic part of the soil, are inactive.

The mobile forms include acid-soluble chemical elements, which make up 50% of the total, and acetate-ammonium soluble elements. These are, first of all, Ni, Cr, Mn, Co, Pb, Cu, Zn, Cd, etc. Assessment of the degree of soil contamination is carried out by the multiplicity of the excess of the content of elements in comparison with the clarkes[1] of substances or with their maximum permissible concentrations (MPC).

The main difficulties arise at the stage of interpreting the actual data on the content of elements and comparing them with a criterion (clarke or MPC). One of the generally accepted classifications of soil contamination looks like this: slightly contaminated soils have a 2–10-fold excess of the clarke; moderately contaminated - 10-30 excess; heavily contaminated - exceeding more than 30 clarkes.

In official documents, the level of soil contamination with gross forms of chemical elements is recommended to be calculated by exceeding the clarke in different multiplicity: copper by 3 times, nickel - 3 times, manganese - 2 times, cobalt - 50 times, zinc - up to 500 times. Physical pollutants of soils and lands. Among the most important physical soil pollutants are noise, vibration and radioactive radiation. Noise pollution - excess of the natural and established noise level, i.e. the pressure of the sound wave. Long-term noise pollution negatively affects the soil biota, which ultimately can become one of the reasons for the degradation of the soil layer. Noise pollution has many natural and man-made sources.

The most important are railway and road transport, production processes and household noise. Vibration is a complex oscillatory process resulting from the transfer of alternating pressure (energy

[1] numbers expressing the average content of chemical elements in the earth's crust, hydrosphere, Earth, space bodies, geochemical or cosmochemical systems in relation to the total mass of this system.

fluctuations) from any mechanical source. Numerous natural and man-made processes can be a source of vibration - earthquakes, volcanic eruptions, transport, industrial activity, etc. Long-term exposure to vibration on the soil cover and underlying rocks adversely affects their condition.

Radioactive contamination - excess of the natural level of radioactive substances in the natural environment. The most dangerous radionuclides entering the soil include strontium-90, cesium-137, cerium-144, yttrium-91, ruthenium-106, niobium-95, plutonium-239 and others. The source of radionuclides entering the soil cover is mainly technogenic processes - the development and enrichment of radioactive ores, nuclear weapons tests, accidents at nuclear power plants, leaks from radio waste burial sites, etc.

Mechanical pollutants of soils and lands. Soils are characterized by the widest range of mechanical pollutants in comparison with other geological environments. The surface of soils and lands is subject to constant pollution with coarse dust. The soil cover is able to accumulate the remains of metal, plastic, glass, rubber, building materials, etc. The main sources of mechanical pollutants are waste from large industrial enterprises, household and industrial waste, agricultural waste.

Biological pollutants of soils and lands. This group of pollutants is also very diverse. By etiology, they are divided into: causative agents of viral diseases - smallpox, HFRS; pathogens of bacterial diseases - tetanus, diphtheria, whooping cough, tuberculosis, anthrax, hepatitis, pathogenic forms of E. coli, etc. pathogens and carriers of diseases of a eukaryotic nature - eggs and larvae of many helminths - echinococcus, hepatic fluke, etc.

Monitoring the state of the aquatic environment. Water plays an extremely important role in all major natural processes. With its high mobility, water penetrates into the most diverse parts of the biosphere. It is in the form of clouds and vapor in the lower layers of the atmosphere, forms seas, oceans and fresh water bodies, forms high-mountain glaciers and powerful ice sheets in the polar zones of the planet. In the process of moisture circulation, atmospheric precipitation penetrates into the sedimentary rocks and forms groundwater. Pollution of natural water bodies can be divided into four types: chemical, physical, mechanical and biological.

Mechanical pollutants include various industrial, agricultural and household waste, partially or completely insoluble in water and not decomposing in soil - plastics, artificial polymers, rubber products, insoluble copper, lead, zinc, etc.

Chemical pollutants include substances of inorganic and organic nature that are widely used in energy, industry, agriculture, medicine and during the operation of military facilities, used as transport fuel. These include metals and their compounds, petroleum products, pesticides, hydrocarbons and others. To date, chemical pollution is the largest and most dangerous type of pollution in the hydrosphere. Physical contaminants include, first of all, sources of radioactive isotopes (^{137}Cs, ^{90}Sr, ^{91}It, ^{95}Nb, ^{131}I, ^{106}Ru, ^{239}Pu etc.), as well as thermal pollution, man-made noise, etc.

The oceans act as an environment that accumulates radioactive waste entering the atmosphere and soil. Water cenoses have the ability to accumulate radioactive isotopes and transfer them in food chains. Thermal pollution is a change in the natural temperature regime of a reservoir due to the release of heat into the environment. Thermal pollution is a type of physical pollution of the hydrosphere and can be caused by natural processes or man-made causes.

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