SYSTEM FOR ECOLOGICAL SAFETY OF A REGION

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Received December 6, 1995

The concept is considered for creating the more efficient system for ecological safety of a region as compared to the existing one arranged according to the territory-administrative principle. Main demands to its structure, principles of arrangement, and necessary spatiotemporal resolution are discussed. Possible complex of the instrumentation is described.

The historically established territorial division of Russia does not coincide in its climatic, physico-geographic, economic, and other characteristic with the administrative one. At the same time, natural processes and anthropogenic effects upon the environment, being rather different in different regions, are beyond the scope of the administrative divisions. As to the existing systems for environmental monitoring, all of them, even at the lowest level, are arranged by the administrative principle and united into the general system at the State level.

The regional level, which is the intermediate one and within which the measures intended for environmental protection should be implemented, turns out to be "administrationless," i.e. there is no body, at this level, which would provide the control over the situation, its analysis, the prognosis of its evolution, social and economic consequences and organize the measures for environmental protection. All the experience accumulated in implementation of such projects shows that the measures for environmental protection undertaken in one or several administrative centers have practically no effect on the ecological situation as a whole. Therefore, creation of systems for ecological safety of a region (ESR) over the whole territory of Russia is an urgent task, especially in view of a very poor ecological situation in Russia nowadays. With regard for local conditions, it is felt that the ESR systems not necessarily must be the same in each region. At the same time, in the general concept of the system of ecological monitoring in Russia the regional level is not so well considered.[1]

1. FUNCTIONS OF THE ESR SYSTEM

The system is intended for continuous control of the environment in a region, including atmospheric air, water objects, underlying surface with plant canopy and technogenic objects, in order to reveal the effects of natural and anthropogenic factors, to evaluate the transboundary transport of pollutants through the region and their balance, to study the long-term changes of the key objects of environment and climate, to forecast the variability of the above factors, to accumulate, process, and store the data, to compile reference books. The system also should record emergencies and disasters occurring in every medium, follow their consequences, and forecast the pre-emergency situations.

2. REQUIREMENTS TO THE ESR SYSTEM

The ESR system should be multipurpose and met a lot of requirements.

2.1. Regimes of operation

The main operational regime of the ESR system is monitoring, in which all its means take part. This regime provides all the administrative bodies interested with the information about the atmospheric air, water objects, underlying surface, and technological objects. The technology of organization of the environmental monitoring is well developed and is not a matter of concern.

The second regime the system should provide is planned surveys of individual natural objects, populated areas or plants. This regime is performed with the use of mobile means and is intended for a comprehensive complex evaluation of the environment.

The regime "Emergency" turns on once one of the ESR system's element gives a signal exceeding a preset level. This regime also turns on in the case when an emergency occurred on the territory of a neighboring region when pollutants come to the territory under control. In an emergency the nearest stationary observation stations are turned into the regime of more frequent observations and the needed mobile means are transported to its location. The regime "Emergency" turns off once the emergency consequences are eliminated or localized or if the pollutants leave the territory under control for an adjacent territory. In the latter case the corresponding center for ESR system control is informed about this.

The regime "Support" serves to widen the functional capabilities of the ESR system. Its function is the numerical simulation of the state of natural objects including the emergency situations, in order to

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prepare a plan for further activity under one or another condition and to predict the state of environment both in standard situations and in an emergency. In addition, in this regime the data are stored and necessary indicators are calculated.

2.2. Space and time scales

From the comparison of physico-geographical features of the territory of Russia, historically established disposition of the main industrial objects, and technical capabilities of the control means (space vehicles, instrumented aircrafts, mobile stations) it follows that every individual ESR system should, on the one hand, cover such a territory, on which natural processes are similar while industrial zones fit in it as a whole. On the other hand, mobile means should be capable to work in the monitoring regime and be in time to arrive in a zone of technogenic emergency soon. Our calculations have shown that within such an approach the area covered by one ESR system, whose structure is described below, is about 1.6–2.4 mln.km^2. This requires creation of 7 to 10 ESR systems throughout the territory of Russia.

The spatial resolution, with which the ESR system should control the state of the environment by indirect (mainly meteorological) parameters, should be from several meters to several tens of kilometers along the horizontal and from several meters to some hundreds of meters along the vertical direction depending on a specific type of the medium and the territory under control. Thus, in regions with background air the resolution can be minimum, whereas in the zone of an industrial center it should be maximum. Other cases can be treated with an intermediate resolution.

As to the time resolution, several versions are now in use in the control systems of different countries. From the first sight, it is desirable to perform measurements as frequent as possible. But this faces a number of problems. First, in a multipurpose system this creates dense information flows, which would require proper resources for their processing and storage. Second, it is economically unprofitable since it causes fast depreciation of the instrumentation and needs for a large staff of operating and maintenance personnel. Third, as the experience of monitoring systems exploitation in some foreign cities shows, the data obtained often are excessive since they carry no additional information. Therefore, it seems worthwhile to consider the experience accumulated in the World-Wide Weather Service which monitors the same natural medium. In the World-Wide Weather Service, standard observations are performed in 3 hours, more complicated and informative observations are done in 6 hours. In the case of an emergency, the regime of more frequent observations with an interval of 0.5 hour is used.

The same intervals can be recommended for the ESR system functioning.

2.3. Objects and parameters under control

The main objects to be monitored by ESR systems are atmospheric air (composition, pollutants, dynamics), water (composition, impurities), soil (composition, pollutants), plant canopy (state, vanishing), and technological objects (state, emissions), as well as technological emergencies (explosions, breaks of oil and gas pipelines, nonsanctioned emissions, etc.) and natural disasters (fires, floods, dam breaks, etc.). For comprehensive and complex characteristics of these objects, the following parameters should be measured:

– thermodynamic characteristics of the atmospheric air which determine the stratification of pollutants, their spread and transport;

– atmospheric precipitation as the mechanism for pollutants removal from air and pollution of the underlying surface;

– gas and aerosol composition of the atmosphere;

– UV, visible, IR, radio-wave radiation fluxes;

– parameters of atmospheric electricity (potential, conductivity, ion mobility, etc.);

– radioactivity of air and underlying surface;

– physical state of the underlying surface and its chemical composition;

– spectral characteristics of the underlying surface in order to reveal its pollution and the plant canopy state;

– spectral characteristics of water surface and turbidity of its upper layer to evaluate its state, pollution, and bioproductivity;

– underlying surface temperature;

– noise, vibrations, electromagnetic fields, and ionizing radiations in the urban areas;

– transboundary pollution transport;

– state of technological objects assessed by the principle "functioning properly/improperly," composition and volume of emissions from organized sources, composition, volume, and motion of the emergency clouds.

3. TYPICAL STRUCTURE OF THE ESR SYSTEM

The system for ecological safety of a region should be constructed by the centralized or group, in the case of a large territory, principle and comprise three subsystems: regional observational subsystem, regional subsystem for telecommunication, and subsystem for data processing, as shown in Fig. 1. In this section we mainly consider the former one – the regional observational subsystem.

The second subsystem is no less important for ESR system functioning as a whole. However, it is not yet created on the regional scale, and this problem will require additional research when creating ESR systems for particular regions depending on the level of development of the local telecommunication network. The subsystem for data processing will be mainly grouped in the system control center or in group centers.

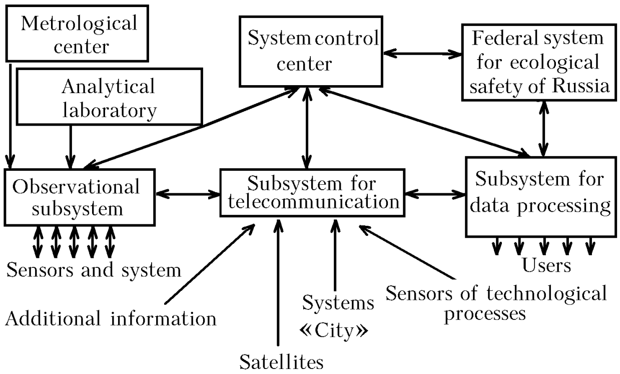

FIG. 1. Typical structure of the system for ecological safety of a region

3.1. Regional observational subsystem

This subsystem is intended for monitoring all the above-listed parameters of the environment, technological objects, and emergencies.

It should be constructed by the principle of spatial distribution and cover the range from microscale (some meters) to macroscales (some thousands of kilometers) to draw up the objective picture of a whole region with sufficient spatial resolution.

As was noted above, the distribution of elements over the territory of a region should be nonuniform. It is known that the major part of ecologically hazardous objects (industrial plants, motor transport) is grouped in cities and looks like linearly distributed objects (oil and gas pipelines, power lines, etc.). Therefore, in the observational subsystem the subsystem "City" should be separated out, which has higher spatial resolution and somewhat different instrumentation base, as well as the subsystems "Technological control" which are based on sensors and indicators built into technological lines. It should be noted that the subsystems "City" are to be operated practically in all regions. As to the subsystems "Technological control", they, in one or other form, exist practically at all enterprises. In the latter case, the problem is reduced to a simpler version, namely, to the connection of subsystems "Technological control" to communication lines for transferring information to the control center of the system.

The same principle can also be used to solve the problem of monitoring of the thermodynamic characteristics of an atmospheric air, precipitation, and fluxes of UV, visible, and IR radiation. These parameters are measured at all stations of the Rosgidromet (Russian Hydrometeorological Center) network which are practically in all regions. The problem can be solved by connecting a communication line to regional Rosgidromet centers collecting the above-mentioned data. As to its organization, the problem can be solved by information exchange between Rosgidromet subdivisions and ESR system control stations also dealing with the hydrometeorological data collection.

To provide a solution of the problems, the regional observational subsystem should include the following complexes (Fig. 2):

– a station for acquiring information from satellites,

– an instrumented aircraft "Optik–E" of the An–30 type,

– an instrumented helicopter,

– stationary observational stations,

– stationary lidars,

– mobile stations,

– mobile stations mounted onboard ships and amphibians,

– analytical laboratories,

– a system control center,

– a metrological center with a base experimental complex.

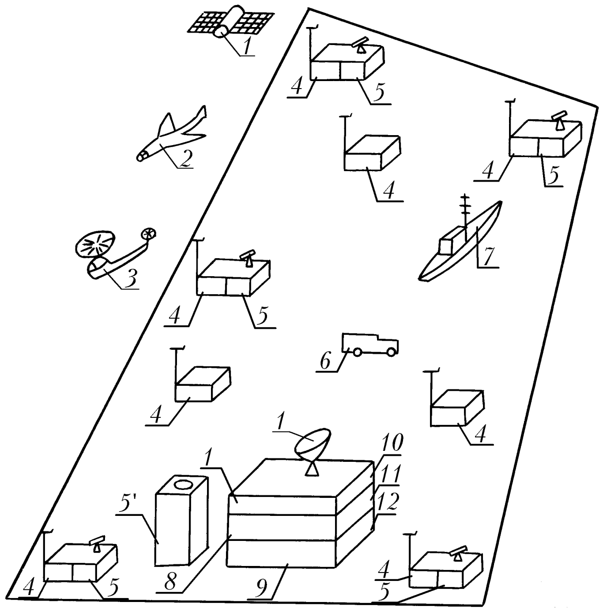

FIG. 2. The structure of the observational subsystem: a complex for acquiring information from space 1, an instrumented aircraft 2, an instrumented helicopter 3, a stationary ground-based observational station 4, a stationary lidar for operation in the troposphere 5, a stationary lidar for operation in the upper atmosphere 5′, mobile on–land stations 6, an instrumented ship 7, an analytical laboratory 8, a system control center 9, a metrological center 10, a center of the telecommunication subsystem 11, a subsystem for data processing and storage 12.

3.1.1. Station for acquiring information from satellites

This station is intended for receiving information from spaceborne platforms within a wide spectral range. This information is needed to assess the state of the environment in a given region as compared to adjacent ones.

For every ESR system it is sufficient to have only one such station with a well operating telecommunication subsystem. It is worthwhile using one of the modifications of domestic production. Such information, on the whole, will be auxiliary.

3.1.2. An–30 "Optik–E" instrumented aircraft

This aircraft, created in accordance with resolution No. 569 of the USSR State Committee on Science and Technology dated by June 15, 1990, for ecological monitoring of the environment, may become a basis for all ESR systems. Its functions in the ESR system are to perform continuous regional monitoring, to participate in planned researches, to study an emergency level and its consequences.

The An–30 "Optik–E" instrumented aircraft is equipped with the following complexes and systems[2]: a navigation system with a video reference to accurately located points, a meteorological system, an aerosol complex, a gas-analysis complex, a Makrel'–2 lidar, a spectrophotometric complex, a thermal imager, actinometric sensors, sensors of γ-background and electric conductivity, and an onboard recording system. This aircraft is capable of solving practically all problems listed in the Section 2.3.

3.1.3. Instrumented helicopter

An instrumented helicopter is intended for surveying local natural and man-made objects when an instrumented aircraft is low-effective due to its high speed. In addition, it should perform the functions on routine service of ground-based stations located in hard-to-reach regions.

The instrumentation complex installed onboard an instrumented helicopter should be analogous to that installed onboard an An–30 "Optik–E" instrumented aircraft.

3.1.4. Stationary observational stations

The stations should be located in most typical places of a region and they are intended to measure the parameters of the environment in the near-ground layer. They should be equipped with a meteorological system, complexes for aerosol and gas analysis, actinometric sensors and sensors of radioactivity, precipitation, and electric conductivity, a system for data acquisition and transfer, a control system to work in autonomous mode, and a system of microclimate, as well as it should include automated tools for air, water, aerosol, and soil sampling.

The number of stations is determined by the area under control with an ESR system as well as the ecological situation on the territory of the region. There are no well-developed techniques to plan the network of such stations, as yet. Available are only some theoretical calculations.

3.1.5. Stationary lidars (laser radars)

Stationary lidars are intended for measuring vertical distribution of concentration of suspended substances carried by wind and atmospheric gases in two altitude ranges of 0–3 and 3–60 km, depending on the performance parameters. The information obtained with lidars is needed when calculating the transboundary transport of pollutants across a region and to evaluate the position of a region in the general (global) system of pollutant transport as well as to determine the vertical stratification of meteorological parameters and impurities.[3,4]

Every ESR system needs for several lidars operating in the 0–3 km altitude range, which should be located along the boundary of the area under control, and at least one high-altitude sensing lidar, operating in the 3–60 km range, which should be located near the center of the territory.

3.1.6. Mobile stations mounted in an automobile van (cross-countring vehicle)

This mobile stations, as well as an instrumented aircraft, ground-based stationary stations, and lidars are the main elements of the regional observational subsystem. In their equipment, the mobile stations are analogous to stationary stations with some additional elements.

Two versions of additional equipment are possible.

In the first version, the mobile stations are equipped with analytical complexes for analysis of air, water, and soil samples in order to widen the set of parameters measured. This type of measurements is not prompt, but with a routine sampling in one and the same place it can be classified as monitoring one.

In the second version, a Raman lidar is mounted in a van for remote sensing of the composition and the volume of emissions from organized sources (high stacks, gas plumes, fires at emergencies, etc.) that cannot be done using other means.[5]

For every ESR system, several such mobile stations are needed, every controlling its part of the territory. It is easy to conclude that such stations are intended for complex planned surveys and for monitoring of the emergency situations. Their number is determined by the area of the territory and the number of industrial and technological objects on it.

3.1.7. Mobile stations mounted on ships and amphibians

Taking into account a wide variety of physico-geographical conditions even within one region, in some cases it is worthwhile to replace one carrier of instrumentation by other. Thus, for example, for the territory of West Siberia, which is often swamped and where there are a great number of medium and small rivers, it is convenient to use small ships such as *Zarya*, boats, and amphibians in addition to motor cars. Equipment in this case remains the same, but ships can come to that regions which are difficult to reach by other vehicles.

3.1.8. Analytical laboratories

At present up to 6000 chemical substances in one or other form come to the environment. Naturally, such a great number of pollutants cannot be monitored with operative devices. Therefore, to determine the set of pollutants in a certain place of a region, air, water, soil, and plant, sampling should be organized with their further laboratory analysis using specialized analytical equipment. Sampling should be performed with the use of the above-listed mobile complexes and at stationary stations.

To satisfy the need for measuring means and taking into account that there are research institutes, higher educational institutes, inspections, etc. on the territory of every region, it is worthwhile to use already existing laboratories with giving them the corresponding status.

3.1.9. System control center

The ESR system control center (SCC) is intended for solving a number of problems: first, to control over the system as a whole, including its turning into the regime of more frequent measurements or to the "Emergency" mode; second, to plan surveys and to organize planned ones; third, to organize the operation of the telecommunication subsystem; fourth, to serve as a basis for the subsystem of data processing. When a large territory is under control, branch centers can be created which will perform the above-mentioned functions for a part of the territory, transmitting already processed information to the head SCC. The head SCC will be responsible, in this case, for interaction with the authorities of territories and the State as a whole as well as with users.

The head SCC is desirable to be located in a settlement with a well developed telecommunication system, closer to the center of the territory under control. Its specific form can be different for different ESR systems.

3.1.10. Metrological center with the basic experimental complex

To unify and standardize measurements within the scope of an ESR system as well as to test periodically the instrumentation, in every system it is necessary to create the metrological center. It will serve for significant reduction of expenses, since the existing metrological centers are mainly positioned in central cities, that will result in frequent and, especially, long-distance transportations from some ESR systems through the whole country.

The basic experimental complex (BEC) should be created at the metrological center that is governed by peculiarities of the object under control itself, i.e. the environment. The matter is that many devices and instrumentation can be tested and certified only under field conditions. The same is also true for the development of many techniques for environmental monitoring. There are no specific recommendations on creation of such complexes, except for the BEC working project developed in VNIIPIET Company by the order of IAO SB RAS.

3.1.11. Subsystem "City"

This subsystem is intended for routine monitoring of the state of air basin over large industrial centers where there are a lot of point and distributed pollution sources.

The typical scheme of this subsystem has been developed in IAO. It differs from all known domestic and foreign systems since it combines two principles which usually form the basis for construction of similar systems, namely, the principle of spatial distribution and the principle of source orientation. Source-oriented are stationary aerosol lidars and wide-frame spectrophotometer "Vzor" which follows plumes movement over a city. Stationary stations, similar to that described above (Section 3.1.4) equipped with sensors of noise, vibrations, and radiations in some city districts serve as spatially representative elements.

In addition to the above, the subsystem "City" includes mobile station, similar to that described in Section 3.1.6, and a sodar for determination of the vertical stratification of the atmospheric thermodynamic parameters, as well as a control center with a local telecommunication system.

This subsystem should be connected with a regional observational subsystem as its branch, that provides for primary data processing in its SCC. For detailed description of the system see Ref. 6.

3.1.12. Subsystem of technological sensors

At many enterprises and technological lines there are sensors following up the course of processes or signaling devices detecting the excess over critical levels, which are connected to corresponding control boards. The signals of sensors and signaling devices installed at enterprises, whose technological processes are emergency-hazardous, apparently should come to the ESR system. In cities it can be done by connecting them to the system "City". Out of cities, signals can come to one of telecommunication branches.

3.2. Regional telecommunication subsystem

Functions of this system include collection of information from elements of the observational subsystems, control over these elements, reception of information from external sources, information exchange with other services and users.

At present one can speak about four possible communication channels: radio channel "object–object", radio relay one, radio channel "object–satellite–object", and a telephone channel. When creating the telecommunication subsystem, the use of any channel can be useful depending on the principles of reliability and cost saving. And the reliability in this case should have a priority.

It is most likely that the combination of the above channels will be in use in this subsystem. Thus, in the system "City," as it is clear now, the telephone channels are most suitable. For mobile means, the use of the "object–object" radio channels is optimal. When collecting information in SCC, the radio relay channel and the "object–satellite–object" radio channel are likely to be used.

Because of the fact that dense information flows will circulate in the communication channels, the low-level units, connected with sensors, should perform the primary data processing and data packing before they enter into the network.

In general, the creation of this system will be governed by the level of the development of local telecommunication systems which are now being actively developed.

3.3. Regional subsystem of data processing

This subsystem is intended for collecting, compilation, storage, and processing of information incoming via telecommunication channels. The subsystem is a part of a branch SCC.

A complex of high-power up-to-date computers connected into a local network forms a central element of this subsystem.

The central complex includes the following main units:

– databases,

– software both general and applied,

– regional mathematical models which allow diagnosis and forecast of the state of environment;

– expert systems,

– subsystem for data display.

Outcome from this subsystem is:

– operative information showing the necessity to take urgent environmental protecting and administrative measures,

– reference data, both climatic (many-year) and sampled, interesting only to few users,

– mapping information,

– information about the transboundary transport of pollutants and their balance in different administrative territories,

– information about long-term changes in different natural characteristics needed when making decisions on social and economic development of territories.

When creating the subsystem for data processing, taking into account that our country is behind in computer technologies, our attention should be focused on the foreign equipment.

4. INSTRUMENTAL BASE FOR THE ESR SYSTEMS

Section 3.1 lists the elements of the ESR system and complexes comprising each of them. In this section let us consider the composition of complexes. When creating them, their instrumental bases should be unified in order to reach comparable results, to simplify the metrology and maintenance, to lower costs in the whole-sale purchases of the instrumentation.

4.1. Measurements of thermodynamic characteristics

These measurements are worthwhile to be performed in two directions:

1) to receive the information common for the whole region, a connection to the Rosgidromet informational network should be done;

2) for measurements, with mobile complexes and stationary points, of, first of all, such basic parameters as pressure, temperature, air humidity, and wind velocity, the sensors of domestic production should be used with their connection to main measuring complexes of the above-listed means.

On the whole, this measuring unit faces no problems and can be completely designed using only domestic instrumentation in collaboration with some Russian enterprises.

4.2. Atmospheric precipitation measurements

At present the parameters to be measured are precipitation amount, intensity, and chemical composition. However, the measurements are not automated and use old-fashioned equipment. As far as we know, in foreign countries the automation of this process also does not come from laboratories. At the same time, the information about precipitation is very important, especially about its chemical composition, since in ecological monitoring it bears the information about the level of air pollution, the balance of pollutants over a region, the quantity of substances precipitating onto the water surface, the ground, and the plant canopy. Therefore, the development of automated precipitationmeters with a tool for sample collection for further laboratory analysis is very important.

4.3. Aerosol complexes

This instrumentation is intended for measuring the mass and number concentration of suspended substances, their chemical and disperse composition.

To measure the aerosol mass concentration, the photoelectric FAN nephelometer (OMZ, Zagorsk) is most suitable.

To monitor the particle number density and the disperse composition, it is necessary to use a combination of PK-GTA photoelectric counters (Vyborg Instrument-Making Plant) and diffusion batteries (IKhKG SB RAS) or electrostatic analyzers (TSI, USA).

No operative measurements of the aerosol chemical composition are known in the world. Therefore, here a classical approach is likely to be used by condensing samples with further laboratory analysis. To use this method in the ESR system, an automated aerosol sampler should be designed.

4.4. Gas analyzing complexes

Taking into account a wide variety of gases comprising an atmospheric air, their monitoring should be done in two ways: operative analysis and preconcentration in combination with laboratory analysis.

Operatively measured should be concentrations of the main gaseous pollutants: CO, SO_2, NO_x, O_3. For such measurements there are commercially available devices. In some regions, regular emissions of specific gases, such as phenol or formaldehyde take place. However, no commercially available gas analyzers for such gases are now available from national market. Therefore imported instruments will also be used.

For regular monitoring of a great number of gases, automated samplers with preconcentration should be mounted on mobile complexes and stationary stations. Samples should be then analyzed in analytical laboratories. As to preconcentration, it will allow the minimum detectable concentrations of some gases to be lowered.

4.5. Measurements of the electromagnetic radiation fluxes

The Russian industry now produces a number of devices to monitor visible and IR fluxes. To monitor fluxes of UV and radio wave ranges, laboratory breadboard constructions existing in a number of institutions should be debugged, otherwise the instrumentation should be purchased from abroad. This problem has received only small attention up to date, but it is very important from the viewpoint of taking into account the long-term trends and the effect of pollution upon the radiation balance and climate changes.

4.6. Measurements of atmospheric electricity parameters

Electric processes play a significant role in the atmosphere. However, many aspects of this problem are now poorly studied. The problem is unavailability of commercial devices, whereas the laboratory breadboard constructions still have many drawbacks. To design such a unit, the automated sensors of electric potential and conductivity should be first designed. The devices produced at the TSI (USA) can be used to measure the ion mobility.

4.7. Measurements of air and soil radioactivity

After the Chernobyl emergency, this type of measurements is being developed intensively. A number of enterprises in Russia have organized a production of a wide variety of sensors. Therefore, there are no serious problems in organizing this unit. The existing sensors should only be built into the main measuring systems.

4.8. Measuring the underlying surface characteristics

This measurements can be performed in two directions. The first one is to sample soil, water, and plants for their further laboratory analysis.

The second one could use airborne spectrophotometers, radiometers, thermal imagers, and lidars.

From the above-listed devices, only thermal imagers are mass produced. Some complexes exist in the form of breadboard constructions in some research institutes. Since this type of measurements is not mass, the problem seems to be solved by using these breadboard constructions, having improved their reliability.

4.9. Lidars

Lidar complexes are now developed in a number of Russian institutions (IAO SB RAS, IKI RAS, GGO, TsAO, IEM, IPG, GIPO). Many of them can be used in the ESR system. The problem is their metrological attestation. It can be organized in the Design and Technological Institute “Optika”.

The station of high-altitude sensing operating at the IAO SB RAS may be a prototype for high-altitude lidars (3–60 km).

4.10. Control over technological objects

This control can be organized in two ways: by connecting sensors built into technological lines to the ESR system and with the help of an instrumented aircraft or helicopter using remote means. In the latter case, some improvements of airborne complexes are needed.

4.11. Automation of measurements

For an operative work of mobile facilities and independent operation of stations, the measurements are desirable to be automated as much as possible. The experience of work with domestic means of automation shows their very low reliability and continuous need for maintenance. To save money and to improve reliability, this part of measuring systems is worthwhile to be assembled on the basis of imported components.

CONCLUSION

In this paper we present only most general, conceptual approaches to creation of the system for ecological safety of a region. It is unlikely that these systems will be immediately constructed everywhere in Russia. The main ideas presented in this paper are likely to be tested on the basis of some region. In our opinion, such a region can be the territory of the West Siberia. The following circumstances favor this. The Program of Climatic and Ecological Monitoring of Siberia works under the aegis of the Siberian Branch of the Russian Academy of Sciences. This Program joins a number of research institutes, both academic and branch ones. On the territory of West Siberia there are the station of the high-altitude sensing of the atmosphere, a set of tropospheric lidars, the instrumented aircraft An–30 "Optik–E", the mobile ground stations mounted. Administrative bodies of the Siberian regions are working under common regional program of "Siberian Agreement," as a result, organizational problems can be solved more easily.

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