Miscellany

The Second International Symposium on Integrated Global Monitoring of Environmental Pollution

(第二回地球汚染監視国際シンポジウム)


Scientists in different countries are paying steadily growing attention to studies of man-induced global effects on the environment in particular pollution effects. It has become obvious that accumulation of harmful substances in the biosphere leads not only to local changes, but also can induce changes on a global scale. Alteration of the chemical composition of the atmosphere, soil, water, and biota can embrace vast areas of land and the world ocean. There are well-grounded concerns that such changes influence the functioning of terrestrial and water ecosystems and bring about changes in climatic and other large-scale natural systems, e.g. the ozone layer. Thus arose a necessity to establish a specialized system for observation, assessment and prediction of man-induced changes in the environment.

The creation of the "Global Environmental Monitoring System" (GEMS) is under the auspices of UNEP (United Nations Environment Programme). Scientific grounds of GEMS are developing within the framework of Project 14 of UNESCO's Program "Man and the Biosphere" (MAB). The practical creation of GEMS fulfills WMO (World Meteorological Organization).

The problem of integrated global monitoring of environmental pollution was discussed in detail for the first time at an International Symposium in December, 1978, at Riga, USSR. The Second International Symposium was held in October, 1981, at Tbilisi, USSR. It was organised by the USSR State Committee for Hydrometeorology and Control of Natural Environment together with the Georgian SSR Academy of Sciences. Co-sponsors were UNEP, WMO, and UNESCO. Scientists and experts from Bulgaria, Czechoslovakia, Finland, GDR (German Democratic Republic), Hungary, Japan, Poland, United Kingdom, USA, USSR, as well as representatives of UNEP, WMO, and UNESCO took part in the Symposium.

The papers and ensuing discussion placed emphasis on various aspects of integrated background monitoring of environmental pollution. The Symposium discussed the present day state of research in the field of observation, assessment and prediction of man-induced effects on the biosphere, as well as ways to establish an integrated global monitoring system aimed at the effective and timely detection of adverse or destructive impacts on natural systems. Attention focused on investigation of the spatial and temporal distribution of pollutants and their effects on land and world-ocean ecosystems, the ozone layer, climate and other important natural systems, and also on biogeochemical cycles of natural elements.

Reports presented at the Symposium reflect the current state of the problem and suggest new theoretical approaches. The latest experimental data on state of the global environment were also presented.

The 9th Session of the Governing Council of UNEP (UNEP/G.C. 9/15: p. 55) recommended that the Symposium in Tbilisi should consider scientific means to increase the global nature of GEMS. Accordingly the establishment of an
integrated network of background monitoring stations on all continents and in the world ocean may become a priority task of GEMS.

Together with plenary sessions where scientific bases, tasks and approaches of GEMS were discussed, the following sessions were held:

(a) Scientific bases for integrated global monitoring;
(b) Monitoring of the levels of environmental background pollution;
(c) Monitoring of pollution effect on ecological systems and climate;
(d) Criteria of environmental quality assessment and standardization; modelling of pollution processes, assessment and prediction of pollution effects on ecosystems.

More than 50 reports were presented at the Symposium.

The programme report "Background Monitoring and its Role in the Global Assessment and Prediction of the State of the Biosphere" was delivered by the Chairman of the Organizing Committee of the Symposium, Yu. A. Izrael (USSR). It is stressed in the report that along with significant anthropogenic loading on large cities and industrial areas, natural ecosystems covering most of the Earth are also exposed to quite extensive, though not great, anthropogenic effects. That is why the integrated background monitoring system is important. The background monitoring extends to biotic and abiotic constituents of ecosystems, to components of the biosphere, and to climatic systems. It should take into account physical, chemical and biological aspects of pollution. Identification of biological factors is the most complex and important problem. Human impact at the background level proceeds indirectly through a general (global or regional) deterioration of biosphere quality. Background monitoring is spreading now. The report shows that the long-range atmospheric transport of pollutants leads to gradual and general pollution and to noticeable ecological effects. The pollutants requiring first priority in background monitoring are sulphur and mercury compounds, and pesticides.

Contamination of the world ocean causes special anxiety. During the last few decades anthropogenic impact has tended to decrease the natural capacity for reproduction and self-regulation in the sea. Four subsystems can be singled out when examining the transportation and transformation of pollutants in seawater: sea-land, sea-atmosphere, and sea-bottom boundary surfaces and the ocean depths. Such critical zones as water-atmosphere and water-bottom boundaries where accumulation of pollutants is considerably higher than in the main water column deserve special attention. One of the most effective means of environmental quality management is to ensure the integrity of the given ecosystem, therefore it differs from that in sanitary points of view. It is necessary to be able to evaluate damage from this or that impact to be able to compare standards for impacts of different origin from economic points of view. The quantitative criteria for measuring environmental quality variations at the background level for some priority pollutants (carbon dioxide, nitrogen oxides, freons, sulphur dioxide, radioactive elements—cesium-137 and krypton-85) and the effects of these pollutants on climate, the ozone layer, ecosystems, atmospheric electric conductivity etc. are formulated for the first time in Yu. A. Izrael’s report.

The nature of global monitoring, its uses, its formation requirements and some other important questions are examined in a report by D.L. Simms (U.K.). It is stressed that few countries can participate in the integrated global monitoring programme, but many countries can participate by developing individual programmes if they meet GEMS objectives.

The role of the study of biogeochemical cycles of various elements in GEMS is well grounded in a report by I.P. Gerasimov and Yu. P. Badenkov (USSR). The processes of migration of substances in the biosphere have a cyclic nature and can change under the influence of man. It is important to study cycles of natural substances as well as those of anthropogenic origin. Oxygen, carbon, nitrogen, phosphorus and potassium belong to the former group of elements. The question of where to site stations for observations of the biogeochemical cycles of elements is also considered in this paper.

A report by V.L. Talrose and I.K. Larin (USSR) is devoted to the problem of atmospheric ionization in connection with the ozone layer. The authors examine not only the well-known role of such neutral particles as OH, NO, and halogen atoms in destroying ozone in the stratosphere, but also consider the influence of some
charged particles, formed under the effect of cosmic rays. An ion-molecular mechanism of ozone formation and destruction is proposed. It is believed that the strongest influence of ionization on the stratospheric ozone may occur in high latitudes during solar flares and, therefore, ozone monitoring is of great interest there.

The regional aspects of integrated ecological monitoring as a bases for taking environmental protection measures against man-made impacts are discussed in a report by V.A. KOVDA and A.S. KERZHENTSEV (USSR). The object of regional monitoring is a certain area: a drainage basin is the most appropriate subject in that field. The authors are conducting research in the Upper Oka river basin (6.5×10⁶ ha). At present they have charts of hydrochemical run-off and changes in plant cover and estimated balances of nitrogen, heavy metals and pesticides.

A number of papers were devoted to land-based integrated background monitoring. The problems of establishment of regional integrated background monitoring stations and of the spatial and temporal synchronization of observations were discussed in reports by B. BÖHM (Czechoslovakia) and by A. JAQUESIETICH and G. PZIBYLSKA (Poland). The choice of station location is crucial especially in highly urbanized countries. Reports by F. YA. ROVINSKY (USSR), L. GAIZAGO (Hungary) and B. BÖHM reflect a successful step towards creating a GEMS subsystem in the East European region. The results of co-ordinated expeditions in Hungary (1979) and in Czechoslovakia (1980) for the integrated background monitoring programme are presented in this report. Data on regional background pollution were obtained, the representativeness of proposed station locations was shown and intercalibration of devices and methods of integrated monitoring of environmental pollution were demonstrated.

In a report by F. YA. ROVINSKY et al. (USSR) the spatial and temporal regularities of pollution in the atmosphere, soil, water and biota were examined. The data were obtained from systematic observations at integrated background monitoring stations and from expeditions. The background contents of ozone, sulphur compounds, particles, heavy metals, organochloric pesticides and 3,4-benzpyrene were discussed. The influence of meteorological conditions on background concentrations of various substances in the atmosphere was shown. A report by G.B. WIERMSMA (USA) presented materials on background pollution in the Olympic National Park and Great Smoky Mountains National Park Biosphere Reserves. Various trace elements (lead, copper, zinc etc.) and organochloric pesticides were studied. Background monitoring in the Baikal Lake Region including the system of integrated observations that embraced the Lake as a whole was described in a report by L.M. FILIPPOVA, YU. A. IZRAEL, A.A. MATVEJEV et al. (USSR). Mathematical modelling for analysis and long-term (20-25 years) prediction of environmental state is a major aspect of their research. A report by G.G. SVANIDZE et al. (USSR) presents peculiarities of pollution effects on natural media in a mountain region (Transcaucasian). It describes mathematical modelling of pollutant transfer processes in various media. A report by Ts. I. BOBOVNIKOVA, S.G. MALAKHOV et al. (USSR) in devoted to the global budget of organochloric pesticides in the environment. Valuable data on background concentrations of DDT and other compounds are presented. The distribution, behavior and migration of 3,4-benzpyrene which has carcinogenic and mutagenic properties are examined; and its background concentration in different geographical zones are estimated in a report by L.M. SHABAD, A.YA. HESINA and A.I. SHILINA (USSR).

The present-day level of background pollution is recorded in the group of reports reviewed above, and provide a basis for detecting longterm trends in the future.

The problems of background monitoring of the atmosphere, mainly in the BAPMON Programme (WMO), are considered in some reports. M.E. BERLYAND et al. (USSR) report on some questions of correlation of global and local monitoring of air pollution. Analyses of observations at background stations in different countries is given. The important role of the atmospheric transport of petroleum hydrocarbons in World Ocean pollution is shown, and calculation of a global budget of these substances of anthropogenic origin is estimated in a report by V.P. ANDREWKOV and I.M. NAZAROV (USSR). A report by K.K. SHOPAUSKAS (USSR) presents the regularities of regional
background atmospheric pollution in the Baltic Sea region. These regularities are defined by site location, atmospheric circulation peculiarities, and also by the Baltic Sea water area. Ozone transportation across the Baltic Sea, transport trajectories and ozone concentrations at stations in Lithuania and Sweden are examined in reports by K. K. Shopauskas, R. V. Gutrzhdene (USSR) and P.I. Greenfield (Sweden). A report by Yu. D. Mateshvil (USSR) deals with some peculiarities of optical characteristics and contents of pollutants of the lower and middle atmosphere observed at the Abastumani Astrophysical Observatory (Western Georgia). The possibility of monitoring atmospheric pollution through the study of aerosols with the help of measurements of atmospheric electricity is discussed in a report by M. Arolld and R. Matisen (USSR). Study of these factors should be included in the background monitoring programme. A report by Ya. I. Gaziiev et al. (USSR) presents some data on aircraft observations of the distribution and chemical composition of aerosols at the heights of 0.1 to 10 km. An assessment of factors causing vertical macro-turbulent diffusion at heights of up to 4 km is given. The application of transmission electron microscopy to the study of aerosols which allows determination of the shape and size of particles with diameters of about 0.01 μm is examined in a report by M. Zier (GDR). A report by A.A. Matvejev et al. (USSR) compiles data collected during many years of research on the chemical composition of atmospheric precipitation in the Baikal Lake Region and their influence on the chemical balance of Baikal Lake. The problems of the composition and stratification of different chemical elements in meteoric water including the ice cover on the Antarctic continent are discussed in a report by V.P. Rusanov and I. Ya. Melnikov (USSR).

A report by Yu. A. Izrael and A.V. Tsihan is devoted to the problem of the world-ocean pollution and monitoring its ecological effects. The main aspects of the problem of ecological monitoring of the world ocean are formulated on the basis of present knowledge of marine pollution and its harmful effects. Research on biogeochemical cycles of chemical elements and pollutants in marine media, and studies of the effects of pollutants on the ocean biota are integral parts of this problem. Ecological and biological effects of changes in sea chemical composition form a chain of inter-related reactions. These reactions are displayed in natural biogeochemical transformation, in violation of cycles of carbon, nitrogen, sulphur and other elements, in biological productivity reduction, and in changes in the cell’s genome. The most important effects of anthropogenic impact are: changes of the mean biomass of planktonic and benthic populations, changes of the number of highest taxons, changes in the species composition of biota with abundant development of certain species, changes in the balance of organic matter production and destruction, and changes in energy flux in the marine ecosystem. The self-purification capacity of a marine ecosystem is examined in the report. The role of biological processes (biosementation, microbial oxidation) in elimination of pollutants from the marine realm is examined.

Pressing questions concerning the monitoring of pollution in the North Atlantic are discussed in a report by A.I. Simonov (USSR). It is shown that time-stable pollution fields of petroleum hydrocarbons, organochloric pesticides and other substances are practically continuous over vast sea areas. According to the author’s model, pollution will increase by several times by the year 2000 and will lead to considerable reduction in primary production. Criteria for assessment of sea water quality are examined in a report by H.V. Velner et al. (USSR), using information collected from all countries in the Baltic region. A report by M.V. Gusev et al. (USSR) presents an analysis of study methods for monitoring the state of microbiological systems in basins contaminated with oil products. Oil oxidizing microflora are important in water purification.

Some reports are devoted to the monitoring of surface water quality in various aquatic environments. The problems of establishment of surface water background monitoring in big river basins is examined in a report by G.P. Andrushaitis et al. (USSR). It is proposed that monitoring systems should be established in these basins in accordance with hydrographical conditions with special attention being paid the drainage basins of small rivers, which are very sensitive to external impacts. The approach given allows
zoning inside big river basins and determination of the rate of anthropogenic impact. A report by K.V. BALOG, YA. SHALANKAI and E. BERTA (Hungary) presents research material on heavy metals concentration in the tissues of different animals in Balaton Lake. Concentrations of Hg, Pb, Fe, Zn, Cd, Cu and Mn were determined in zooplankton, mollusks and fish. A report by P.I. KOROLENKO and G.S. KOTLJAREVSKAJA (USSR) is devoted to the monitoring of dissolved oxygen. The use of paleobio-monitoring for detection of man-induced effects in fresh-water ecosystems is examined in a report by A.M. NIKANOROV and A.V. ZHULIDOV (USSR). The authors show a nine-fold increase in lead concentration in some dated samples of water plants over the last 70 years. Eutrophication of water bodies and its monitoring is examined in a report by H. SEKI (Japan). According to the degree of eutrophication of a watermass, amplitude of the steady-state oscillation of turnover time of organic matter increases within a certain range that is bounded by thresholds, and the trophic state in the watermass finally reaches the next trophic state by irreversibly crossing over the threshold.

Much attention is paid to the problems of biological monitoring. A report by V.E. SOKOLOV et al. (USSR) shows, that monitoring of terrestrial ecosystems is based on the study of endogenic and exogenic succession. It is important to determine the nature of systems of succession within those system, e.g., production and decomposition of organic matter, and to investigate its accumulation or loss are very important parameters. Monitoring of ecosystems continuously over many years following a specialized programme is examined in a report by BREYMAYER (Poland). A report by L.M. FILIPPOVA et al. (USSR) is devoted to changes in the state of vegetation under the impact of background levels of SO2. The effect of background concentrations on the photo-synthesising cell is defined, a model of this process is developed, and the total global effect on vegetation is shown to be comparable in magnitude with the general effect in areas of heavy SO2 pollution. The role of biotesting within biological monitoring is considered in a report by K.S. BURDIN (USSR). Testorganisms can be used to assess pollutants' effects according to the "dose-effect" mechanism. Detection of SO2 in the air by means of pine needles is examined in reports by J. JOKINEN, R. KARJALAINEN, A. KULMALA (Finland) and M. NEUMARK, J. SAS, L. FRIDVALSKY (Hungary). The contents of organic and non-organic sulphur in needles depend on SO2 absorption from the air. Changes in needle chemical composition along with physiological changes allow the pine tree to be a good biological indicator of atmospheric pollution. Results using such biological indicators correlate well with models of SO2 distribution in the atmosphere. The problems of using biological indicators for monitoring air pollution are also considered in a report by M. KOVACH et al. (Hungary). The accumulation of various toxic elements, such as Pb, Zn, Cu, Mn and Fe, is also examined in this report.

Some reports deal with probable climatic changes connected with anthropogenic activities. Probabilistic and statistical methods of climate monitoring on the basis of observations over the last century in the Northern hemisphere and some of the problems involved in the establishment of a climate monitoring system are discussed in a report by G.V. GRUZA (USSR). Monitoring of stratospheric aerosols and their effect on the Earth’s climate is the subject of a report by S.S. KHMELEVTSOV (USSR). Long-term observations of stratospheric aerosols are necessary for predicting climatic changes. The monitoring system including land radar stations, aircraft and balloons is examined in this connection. A report by R.L. KAGAN, I.L. KAROL et al. (USSR) is devoted to assessing the accuracy of measurements of minor constituents in the atmosphere in connection with climate monitoring. Representativity of observations of climate-forming factors (e.g. total ozone contents) is considered with respect to spatial and temporal averaging. Some principles for dividing regions into zones according to climate characteristics for monitoring recent climate changes and for detection of areas with potentially unsteady ecosystems suffering from pollution are advanced in a report by Yu. V. KURILOVA and P.A. KOLOSOV (USSR).

The most important components of integrated monitoring, namely the methods assessment and prediction of environmental quality, are considered in another series of reports. A report
by Yu. A. Izrael, I.M. Nazarov and A.G. Ryaboshapko is devoted to the development of approaches to standardize emission levels of atmospheric pollutants. Three groups of substances are recognized depending on the scale of pollution. For substances of a global character: it is suggested to standardize emissions according to certain quotas for different countries. For substances of a regional character: it is suggested to standardize emissions on the basis of transboundary fluxes of regions and countries. For substances of a local character and short life-time: it is suggested to standardize emissions on the basis of bilateral agreements and mutual interests. The role of ecological and economic models for prediction of environmental quality is discussed in a report by M. Ya. Antonovsky et al. (USSR). These models take into account social, economic and ecological factors of development in the country concerned. A report by F. Rudolf (GDR) presents another predictive model of environmental pollution which is meant for use in a general scheme of industry. A report by S.M. Semenov and L.M. Filippova (USSR) is devoted to the prediction of the state of biota within the ecological monitoring system. Rate of population increase is chosen as the main parameter characterizing individuals. The rate together with coefficients of interspecies interactions enter directly into a model for predicting changes in the state biocenoses occurring in response to man-made impacts.

The reports and discussion on the whole illustrated that a number of countries have initiated national programmes of background monitoring using an integrated approach. The first results of integrated observations have been obtained in GEMS regional subsystems, in particular in Europe, in the USSR, in the USA and other countries. The Recommendations adopted by this symposium are directed at the further development of research in the urgent field of pollution problems and at the practical establishment of GEMS.