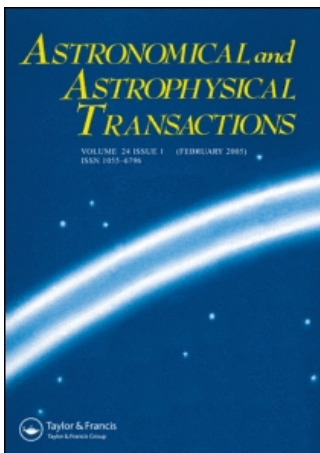


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ROLE OF INTERNATIONAL COOPERATION IN THE FIELD OF SPACE RESEARCH IN THE SUSTAINABLE DEVELOPMENT OF THE NATIONAL ECONOMY

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The Azerbaijan National Space Agency (ANASA) was established in 1975 for the coordination of scientific, fundamental and applied research in the field of remote sensing of the Earth and the application of these results to assist development of the national economy of the country.

Keywords: International cooperation; Space research

The Azerbaijan National Space Agency (ANASA) includes the following establishments.

- (i) The Institute for Space Research of Natural Resources has the following tasks:
 - (a) acquisition, registration and data processing of remote sensing (RS) of the natural resources of the Earth;
 - (b) RS of a spreading surface with the help of on-board measuring complexes;
 - (c) development of measuring complexes for ground and sea research.
- (ii) The Institute of Space Computer Science has the following tasks:
 - (a) development of methodical and algorithmic tools and software for thematic interpretation of the space information;
 - (b) mapping of results of the space shooting data interpretation.
- (iii) The Institute of Ecology has the following tasks:
 - (a) development of methods of regional ecological monitoring on the basis of RS data;
 - (b) development of models of natural disasters and database of ecological monitoring;
 - (c) development of methods of increasing the efficiency of the rating of land fertility, irrigation systems and petroleum pollution of water.

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- (iv) The Special Design Bureau (SDB) has the following tasks:
 - (a) design and development of devices and equipment on the basis of the research and experiments carried out.
- (v) The experimental plant has the following tasks:
 - (a) development of model samples of devices and systems from the results of work by the SDB.

ANASA today is a collective of up to 822 people, 541 of which are scientific employees; five are doctors of science, and about 100 candidate of science from various areas of science and engineering actively work in the organization. Among the employees of ANASA there are graduates of the leading high schools of Moscow, St Petersburg, Samara, Volgograd, Kiev, Minsk, etc. Today our experts pass training courses far outside Azerbaijan republic – in Holland, Italy, Thailand, etc.

During the period of existence of the former USSR, international cooperation in the field of space research was carried out centrally within the USSR framework. In those years, ANASA was assigned the duty of organization of research about the Earth from space; already in 1977 and 1980, in Baku, UN educational seminars on the application of RS had been held. In this period the idea of realization of multilevel experiments on RS was actively discussed. The essence of the idea is in the synchronous review of the same area (a spreading surface site) at various levels and acquisition of remote data about the Earth on various scales under identical research conditions, such as atmospheric and weather conditions, and height of the Sun, with the purpose of defining how the scale of the image influences the opportunity to decode the elements of a landscape. Also, the results of these observations allowed comparison of the RS data with the results of contact measurements on test ranges. In those years the INTERCOSMOS Council of the former USSR organized polygon experiments in all socialist countries. In the next few years such experiments were carried out in Cuba, Mongolia, Poland, Czechoslovakia, German Democratic Republic, etc. In August 1984 a similar multilevel experiment named Gunesh-84 was planned, organized and executed on the test range of ANASA. During the experiment a space vehicle (Soyuz 9), a plane (AN-30), a helicopter and two tower automobiles with gauges at various heights were involved and simultaneously contact ground measurements were carried out, in total making synchronized six-level experiments. The number of various devices and gauges involved during the experiment was more than 30. More than a dozen various methods and principles of measurements used in various organizations of the former USSR and the countries of the Council of Economic Mutual Aid were also approved. Based on experience obtained during Gunesh-84, this experiment was continued in the Kursk area during the Kursk-85 experiment.

At the end of the twentieth century the USSR disappeared from the political map of the world and new independent states have appeared in this territory. The break-up of the USSR has led not only to breakdown in political communications between former republics, but also to infringement of economic relations with all its consequences. As a result, assignments to science and education were reduced. Statistics show that the USA spend about 7% of the annual budget on science, which is 1.6 times more than the total annual budget of Russia and about 100 times more than the budget of Azerbaijan. On the average in the USA about US \$200 000 per year are needed for one scientist, in Japan US \$120 000, and in the developed countries of Europe up to US \$90 000. The cost for one scientist in Azerbaijan today is less than US \$1000.

In these new conditions, Azerbaijan, and ANASA in particular, has found itself in a situation where it has had to start from 'zero'. As Russia, as the successor of the former USSR, in

practice automatically remained the member of different international communities and organizations, ANASA needed to make much effort and time to put forward its case.

International cooperation became the priority for ANASA. In 1994, Azerbaijan took part in the First Ministerial Conference on the Application of Space Science and Technology for Steady Development of the Region of Asia and the Silent Ocean (Pekin) and since then has been actively involved in realization of the Working Plan for Steady Development. Since 1995, cooperation with the UN Economic and Social Commission on the Countries of Asia and the Silent Ocean (ESCASO) began. ANASA represents the country on the Interstate Advisory Committee on Remote Sensing. The experts of the Agency regularly participate in working groups of the Interstate Advisory Committee on Meteorology and Communication. In October 1997 the Regional Seminar on the Application of Space Technologies for Steady Development of Agriculture in the countries of the region organized together with ESCASO, the Food and Agriculture Organization (FAO) (UN) and the European Space Agency was carried out in Baku.

Together with various international organizations, our experts participate in performing some projects. In 1999 within the framework of the NATO programme 'Science for the sake of the world', together with the countries of the Caspian region the project 'Caspian sea for planning of the future actions' was executed. The basic purpose of the project consisted in developing a plan of action for monitoring of the status of the Caspian sea.

In 1998 and 1999 within the framework of the STRIM European programme, accepted in 1997 at the meeting of the participants of the Open Partial Agreement of European Council, the work of rating the seismic parameters of the risk of active tectonic structures and forecasting of possible earthquakes was carried out. The work was performed together with the Centres of Science of France, Georgia, Greece and Russia. Within the framework of this project the STRIM project 'Space technologies and Geographic Information Systems (GIS) for the seismic control of risk and active tectonic structures' was carried out.

In 1997 in Baku a UN seminar on the use of RS data in the interests of a national economy was organized (Fig. 1); after this within the framework of the technical help to the Ministry of Agriculture of Azerbaijan, FAO (UN) implemented the realization of a project on the land



FIGURE 1 Group attending the UN seminar in Baku in 1997.

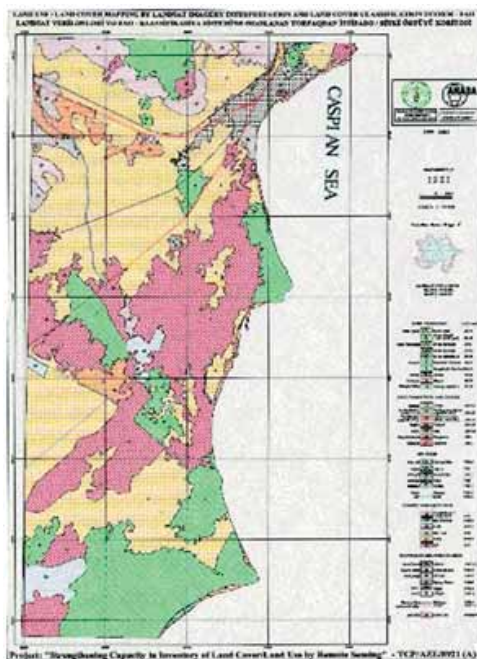


FIGURE 2 Map of Azerbaijan obtained by ANASA.

cover and land use mapping of all the territory of the country on a 1:50 000 scale. As the basic information for this project was in the form of LANDSAT 5TM space images, the executors involved in the specified project were the experts at ANASA.

The project was carried out from July 1999 until June 2001. Among the experts of ANASA a group set up which, having finished the FAO (UN) training courses, during the next 1.5 years carried out the project of land cover and land use mapping of all territory of the country on a 1:50 000 scale.

During realization of the project the group, using modern software (ArcView, ENVI and ERDAS) and consistently carrying out all stages of GIS (technologically processing the digital (space) and accompanying analogue information) finished the project by printing maps of all the territory of the country (Fig. 2).

On the basis of the complex analysis of the ground data together with the space images (1998–1999) for the first time in Azerbaijan a complex digital model was constructed in the Gauss–Kruger projection. It includes the following:

- (i) basic topographical maps on a 1:100 000 scale;
- (ii) basic thematic maps (climatic, ground, geomorphologic, physical and general geographical) on a 1:500 000 scale;
- (iii) digital map of land cover and land use on a 1:50 000 scale;
- (iv) digital database of land cover and land use;
- (v) linear objects (river, channels, highways and railways).

As a result of the project the members of group have received certificates from the FAO (UN).

In the near future, work on mapping the salted sites of the country, the dynamics of change in wood files, the level of water, etc., are planned.