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***UNECE Working Group on Environmental Monitoring
Task Force on Remote Sensing***

in cooperation with the Ministry of Ecology and Natural Resources of Azerbaijan

and with the financial assistance of the European Community



***The Second Workshop
on Remote Sensing Applications for Environmental Monitoring***

3-4 November 2003, Baku, Azerbaijan

Report of the meeting

1. The workshop on remote sensing applications for environmental monitoring was held on 3-4 November 2003 in Baku, Azerbaijan.
2. The workshop was attended by experts from Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, and Uzbekistan, representatives of the European Environment Agency (EEA), the Regional Environmental Center for Central and Eastern Europe (REC CEE), and Institute for Environment and Sustainability of Joint Research Centre of the EC (JRC) (See annex A List of participants).
3. The meeting was opened by organizers: Goussein Bagirov, Minister of Ecology and Natural Resources of Azerbaijan, Vittorio Barale, head of Task Force on Remote Sensing (JRC), and Yaroslav Bulych (UNECE) welcomed the workshop participants. Goussein Bagirov noted importance of remote sensing applications for environmental monitoring and assessment in Azerbaijan and briefed on activities carrying out in this area in the country. Vittorio Barale talked about efforts of Task Force on remote sensing. He noted importance of the second meeting in Baku and its coherence with the first meeting held in spring of 2003 in Ispra, Italy. Yaroslav Bulych emphasized goals of the meeting, namely discussion of the structure and the components of project proposal, roles of the national institutions and partner organizations, the work schedule and potential sources of finance for future project.
4. Presentation of the project proposal (see annex B) prepared by JRC in co-operation with UN ECE, UNEP, and REC CEE was made by Vittorio Barale. He briefed on political, technical, geographic, and ecological aspects of the project proposal. In particular, main goal of proposed pilot program is to demonstrate trial assessment of the environment of the Eurasian region based on data of remote sensing.

5. The proposal is focused on problems stretching from local through regional/basin till (quasi-) continental level. At the local level special attention will be given to the problems related to man's impact on the environment (e.g. urban sprawl, transport corridors, "hot spots"). At the regional or basin level water resources problems should be given consideration, starting from management of coastal and marine areas and ending by monitoring of lakes, snow cover, and glaciers. At the continental level issues of land cover, land use and soil degradation (e.g. desertification) should be given consideration. According to the conceptual approach of EEA the proposal will be focused on using (already selected) environmental indicators based on data sets, which are relevant to environmental policy, timely and accessible, and if possible on time series. In addition to that Vittorio Barale noted topical character of the project proposal and briefed on work packages from which project activities will be consist of.
6. Thereafter Jerome Simpson on behalf of REC CEE made comments on project proposal. In particular, he suggested to name the project "Demonstration of remote sensing applications for environment assessment and management" (DREAM). Other key suggestions were as follows:
 - To divide project into four work packages instead of three work packages as it was proposed earlier.
 - To procure equipment as an essential requirement for the project.
7. The discussion of introduction and sections 1.1-1.3 of the project proposal concerned the following issues:
 - Role of the leading organization. It was noted that only one leading organization should coordinate the project. While other partner organizations may play as a leading organization in the individual work package. They can provide technical, methodological and other necessary support to the organization – project coordinator.
 - Equipment procurement. It was emphasized importance of equipment procurement for the project. The participants were informed that within the framework of current project Tacis have already supplied all the countries with computers, printers, and scanners. This equipment can be used in future project on remote sensing. Providing with the specific software for processing space images is more important. It was said that in the beginning of the project analysis of equipment needs for each country should be made.
 - Scope of the project. It was pointed that initial conditions are not equal in different countries. It was suggested to divide all the countries into two groups (beginning and advanced) and set different tasks for them. However most of speakers agreed that there is no need in such breakdown and research should be carried out in different countries at the same level. There was an exchange of views on use of different spectrum range for data collection from remote sensing. It was noted that using only visible spectrum limits the number of problems to be solved. It was suggested to use infrared and microwave spectrums, as well as radar aids. It was also noted that because of the fact that some of the countries are not ready to carry out wide range of tasks the simplest task should be selected. It was mentioned importance of verifying space satellite data with use of methods of ground-based observations in spite of their higher cost.

8. Discussion of introduction and sections 1.1- 1.3 of the project proposal summarized by the following:
 - Sections 1.1- 1.3 of the project proposal (Political aspects. Technical aspects. Geographic and Ecological aspects.) were approved.
 - Rio Process and UN Millennium Development Goals should be included in section 1.1.
 - Last paragraph of Section 1.1 should be added by “Preparation of strategic and technical documents for providing decision-makers with information based on remote sensing.”
9. After-lunch discussion concerned development of methodology. Lubos Kucera first presented the environmental indicators used by EEA to assess state of land cover and its change. He noted that used set of the indicators is not static, it is constantly being discussed and updated. He gave examples of using remote sensing data to create and load GISs.
10. Vittorio Barale and Niall McCormick gave some examples of the environmental indicators based on data of remote sensing. They said what kind of information can be obtained using these indicators. In particular, Niall talked about using data of remote sensing for assessment various environmental issues.
11. Mikhail Bukharov briefed on use of remote sensing in Russian Federation to solve wide range of problems (assessment of ice conditions on rivers, monitoring of hazardous radiation background above Black Sea, emergency monitoring etc.).
12. Further discussion concerned following issues:
 - Complication of working out methodology. JRC should play as leading organization in the work package including task on methodology development because only specialists of the JRC are qualified enough to do this work.
 - Methodical documents. It was suggested to work out strategic document «Guidelines for environment monitoring and assessment based on remote sensing” and submit it for approval of Ministerial Conference in Belgrade in 2007. Besides it was suggested to work out package of regulatory and methodological documents. For EECCA countries it was suggested to use Technical Guidelines of CORINE Land Cover (CLC) project as a methodical handbook.
 - Tasks on remote sensing. It was suggested to divide all tasks of the project into categories: operational and non- operational. Operational ones should serve to support decision makers in emergencies such as fires, flooding, burst emissions of environmental pollutants. It was noted that for this project images of low resolution can be used for investigation of problems on sub-continental and regional levels. While for solving problems of “hot spots” images of high resolution can be used. Relevant equipment is to be available to use images of high resolution (20x30m).
13. It was decided to approve Section of the project proposal on methodological issues as a whole. Suggestions and comments obtained as a result of the discussion should be included under finishing off the Section.

14. First morning session of the second day of the meeting concerned dissemination of information about project to potential end-users. In particular, following issues were discussed:
- Appraisal of end-user requirements is necessary;
 - It is desirable to work out detailed business plan for nearest 5-10 years including works on commercialization of the project;
 - End –user insolvency for the most part of the countries. State institutions with budget financing are the main users of information. It was expressed concern that after finishing the project and discontinuing provision of external or internal funds national points created during the project stop functioning;
15. Second morning session of the second day of the meeting concerned demonstration of data applications. In particular, following issues were discussed:
- Definition of a “hot spot”. All the participants agreed that “hot spot” is an urgent environmental problem localized on small area.
 - Information about “hot spots”. Each country which has not sent this information yet, can send it by 13 November, 2003. Information should include description of the problem, underlying reasons, national actions to overcome the problem, other information concerning this problem.
 - Levels of the project. Participants of the meeting came to a conclusion that land cover problem will be investigated on continental level; problems of Caspian Sea region and glaciers of the Caucasus and Central Asia mountains – on regional/basin level; and “hot spots” – on local level. It was noted that investigation of “hot spot” is optional. It depends on interests of individual country.
16. Project management issues were discussed during after-lunch session. It was noted that key project partner in each country is the Ministry/Committee of environmental protection. Research institutes and other organizations are considered as partner organizations.
17. Potential donors. Following organizations were mentioned as potential donors of the project:
- GMES Programme. This Programme is focused on EC countries, it is not clear if it can finance EECCA activities. At the same time European Development Fund finances an associated GMES Programme for Africa (PUMA). Conclusion: GMES can be used as a political instrument in searching funds for the project proposal;
 - GEF (Global Ecological Fund). Direct investments from GEF can be received by a country or regional project. Three partner organizations finance regional projects (World Bank, UNDP, UNEP). Conclusion: Ron Witt can be asked to consider possibility of GEF financing the project proposal.
 - Tacis Programme. This programme finances current project. Next project proposal cannot be applied prior to the final report of previous project is approved by project monitors. Conclusion: At present time Tacis Programme is not a potential donor for the project proposal;
 - EBRD. This organization mainly grants loans, but grants. Conclusion: It is not a potential donor for the project proposal;
 - Soros Fund. It is focused on problems of civil society. Conclusion: It is not a potential donor for the project proposal;
 - Secretariats of the Conventions. They have low budgets. Conclusion: They are not potential donors for the project proposal;

- ADB (Asian Development Bank). ADB finances a number of projects in Central Asia. Conclusion: ADB is a potential donor for financing research activities in countries of CA.

18. The general conclusions of the Workshop on remote sensing applications for environmental monitoring are as follows:

- Require to UNEP, JRC, REC CEE, and UN ECE to finishing off the project proposal;
- UNEP should consider possibility of submission of the project proposal with potential financing from GEF by the end of current year;
- A leading organization of the project should coordinate the whole project in close co-operation with leading organizations of individual work packages of the project;
- Each country, which has not sent information on “hot spots” yet, and is planning to join to this part of the project, can submit it to the UN ECE Secretariat by 13 November 2003.

Annex

Demonstrating Remote Sensing for Environmental Assessment and Management (DREAM)

PROJECT PROPOSAL

Geographical scope:

Eastern Europe, the Caucasus and Central Asia (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan).

Cost of Project:

For the start up phase, a budget of Eur 250,000 is envisaged. For the 2nd, 3rd and 4th phase a further Eur 2.75 million is required.

Cooperating Agencies or Supporting Organizations:

The project will be led by the European Environment Agency (tbc) with technical assistance provided by the EC's Joint Research Centre. The Regional Environmental Center for Central and Eastern Europe together with REC offices in the EECCA region will support project coordination, besides capacity building and results dissemination. UN organisations (UNEP, UNDP and UNECE) will support data acquisition, equipment disbursement and overall network coordination respectively. Successful project management will be assured via five Steering Committee meetings.

Duration of Project:

3 years

Commencing: March 2004

Ending: March 2007

1. Background

1.1 Political Framework

The "Environment for Europe" process, under the aegis of the United Nations Economic Commission for Europe (UNECE), aims to foster international cooperation to safeguard the pan-European environment [1]. As part of this process – after the 4th Ministerial Conference "Environment for Europe", held in Aarhus, Denmark, in 1998, where Environment Ministers recognized that mechanisms for coordinated monitoring, data collection processing and management in the pan-European region, and in particular within countries in transition, such as those of Eastern Europe, Caucasus and Central Asia (EECCA)¹, were often inadequate –the UNECE Committee on Environmental Policy (CEP) established an *ad hoc* Working Group on Environmental Monitoring (WGEM) in 2000.

The Working Group was charged with providing recommendations, proposing action plans and strengthening international initiatives, within the UNECE region, dealing with environmental

¹ Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

monitoring and related issues. WGEM supported the preparation of the 3rd pan-European environmental assessment report (*Kiev Assessment*) by the European Environment Agency (EEA), in particular, by collecting data and information in EECCA countries. It developed *Recommendations on Strengthening National Environmental Monitoring and Information Systems in Eastern Europe, the Caucasus and Central Asia*, and *Guidelines for the Preparation of Governmental Reports on the State and Protection of the Environment*, that the Ministers endorsed at the 5th pan-European Conference “Environment for Europe held in May 2003 in Kiev. The Working Group set up networks of experts from EECCA countries to improve knowledge about available tools, guidelines, methods and classifications, developed by the EEA and other international organizations and institutions in the fields of information technologies; monitoring of air pollution, inland surface waters and waste; environmental indicators; state-of-the-environment reporting; and remote sensing. These achievements were made possible thanks, to a great extent, to financial support by Denmark and the European Commission (EC) within its 2002-2003 Tacis project on strengthening environmental observation and information capacity in EECCA.

At the Kiev Conference, the Environment Ministers supported the Working Group in its activities on strengthening environmental information and observation capacity in EECCA. They recognized that, at the regional level, further development of the cooperation framework provided by the Working Group was required and they invited donors to support the Working Group and the work for the fourth assessment report by EEA.

The present Proposal originates from one of networks of experts, the Task Force on Remote Sensing (RS) that was established by WGEM with the leadership by JRC. The Task Force has the objective of forming and training a group of end-users, so that a key set of RS-derived indicators be identified and mapped, by means of a **Pilot Program** for environmental assessment of the Eurasian macro-region. A series of complementary measures, consisting of an opportunity awareness campaign for end-users, a suitable set of capacity building activities, and an application demonstration exercise, will constitute the core activities proposed.

The Task Force believes that this set of measures will:

- Help to develop environmental indicators on the basis of RS-derived data;
- Build capacity of EECCA countries to use RS for environmental assessments;
- Contribute to harmonization of environmental assessments in the UNECE region;
- Provide input to the 4th pan-European environmental assessment report for the next Ministerial Conference “Environment for Europe” (requested within paragraph 30 of the Kiev Ministerial Declaration);
- Associate EECCA countries with the cooperation on the Global Monitoring for Environment and Security (GMES) initiative under joint consideration by the EC and the European Space Agency (ESA) [4].
- Preparation of strategic and technical documents for providing decision-makers with information based on remote sensing.”

1.2 Technical Framework

A proper use of RS techniques, considered as a component of an integrated set of observations, can provide an important contribution to monitoring and reporting on the state of the environment [2]. This contribution is particularly significant when the observations aim to an assessment of large-scale and long-term environmental conditions, over the regional to continental range, and over the entire seasonal cycle.

Indicators derived from RS data are powerful, if not unique, tools for studying and monitoring various processes on the planetary surface, provided that basic Earth Observation (EO) concepts — including both potentials and limitations — are well understood [3]. The main problem to be solved, in order to fully exploit the capabilities of the technique, is that RS produces large amounts of data, which must undergo several levels of processing, (requiring special facilities and expertises) to derive suitable indicators, before reaching the end-user.

In the present case, it is suggested to exploit the potential of optical RS to observe the Earth surface in the visible spectral range, and to derive from such observations quantitative parameters that would complement ground-based measurements. Further, it is proposed to consider parameters related to surface conditions, both on land and in relevant marginal and enclosed basins, as the starting point for the derivation of specific indicators – *e.g.* such as parameters describing the living biosphere – and for the evaluation of the continental state of the environment.

Satellite RS systems offer specific benefits to the efforts for environmental safeguarding in Europe as they:

- enhance the state-of-the-environment reporting by complementing existing ground (and airborne) data collection systems, by providing unique time series information, showing spatial and physical changes; data on trans-boundary issues; and in selected cases, an affordable and timely alternative to *in situ* assessments;
- support the monitoring of compliance with environmental legislation;
- support the monitoring of progress in implementation of policy targets; and
- enhance the information base of the policy planning process, and quality of resulting decisions made for environmental protection.

1.3 Geographical and environmental framework

The area of interest for the present Pilot programme is the EECCA region. This includes countries, in which the situation concerning environmental monitoring and reporting varies substantially. Given this situation, any effort to improve current capabilities to exploit the RS potential for approaching several specific national and trans-boundary environmental problems, as advocated by the present Proposal, must take into account the variable level of technical means and expertise available in the countries concerned. The Pilot Programme will have a substantial capacity-building component, in addition to the development of specific application demonstration examples.

The environmental problems to be approached in the Pilot Programme proposed here range from local scales, to regional or basin scales, as well as to (quasi) continental scales. Locally, the main focus would be principally on issues linked to anthropogenic pressure on the environment (*e.g.* urban sprawl, transportation corridors and environmental “hot”spots). At regional or basin scales, the attention would shift mainly to water issues and resources, from coastal and marine management to monitoring of lakes, snow cover and glaciers. At the (quasi) continental level, land use/cover and land degradation would be the issues attracting by far the greatest interest.

As for the RS techniques best suited to tackle the suite of environmental problems outlined above, it appears that parameters derived from optical observations, at high to medium space-time resolution, would allow an effective monitoring of most of the phenomena of interest. As an example, parameters linked to vegetation (cover, type, biomass), both on land and in water, could be one of the key indicators to be derived from optical RS data, with applications in the fields of anthropogenic impact, water quality, desertification processes. Following an established EEA approach, the present Proposal will concentrate on the use of (already identified) indicators, derived from policy-relevant and affordable time-series data sets.

2. Pilot Programme Description

2.1 Goal and specific objectives

The main goal of the proposed Pilot Programme is the demonstration of an environmental assessment for the Eurasian region, based on RS data. The demonstration process shall be used to foster the development of technical capabilities in support of future environmental monitoring and reporting in the EECCA region. The assessment will focus on a few critical themes, and should aim to provide a baseline atlas of some specific environmental indicators. The key problems and priorities, currently identified as being critical issues in the Eurasian region, are those of desertification, soil degradation, deforestation, habitat changes, urban sprawl, surface waters availability and quality, both in the terrestrial and the marine environment, and “hot spots” contamination.

The Pilot Programme will allow to produce regional maps of indicators related to the above critical issues, as derived from suitable RS data, at high space/time resolution, for selected Eurasian territories (e.g. eastern Europe, Caucasus, central Asia) and marine basins (e.g. Black Sea, Caspian Sea, Aral Sea region) – as well as at the full continental scale, at an appropriate reduced resolution. The monitoring requirements with highest priority, the best suited indicators, and the required space/time scales, will be determined by means of intensive end-users consultations. This application demonstration exercise will be accompanied by an opportunity awareness campaign and other capacity building activities aimed at the same end-user community.

The specific objectives of the Pilot Programme are summarized by the following package of measures, which should be implemented over the course of 3 years to help in exploiting the benefits of RS techniques:

1. Establishing a steering group (representative from selected EECCA countries, JRC, UNECE, UNEP, EEA, REC CEE – max 15 persons in total) to guide and oversee project development;
2. Establishing a network of contact points involved in environmental reporting, data gathering and RS data management in each EECCA country, to be involved in a series of user consultation and information sessions;
3. Publishing guidelines and handbooks describing the methodology and approach needed to integrate RS data into national environmental reporting, including cost benefits, and illustrating indicators for standardized European environmental reporting;
4. Collecting and updating baseline data sets (from existing RS data archives), for the EECCA problem areas and for key EEA-defined environmental indicators;
5. Developing sample RS-derived, value-added data sets, in the form of indicator atlases, and a methodology for integrating such data into environmental reporting to fill information gaps critical to decision-making process;
6. Offering training on RS data handling, processing and environmental reporting in EECCA countries, as a mean to build capacity, exchange experience, identify obstacles and foster networking.

2.2 Relevance

Results from the proposed Pilot Programme would provide an important input to ongoing and near-future environment assessments covering the pan-European area, including the next report of the EEA on the state of the European environment (to be prepared for the 6th Ministerial Conference “Environment for Europe”, to be held in Belgrade, Serbia, in 2007), as well as the 4th edition of

UNEP's Global Environment Outlook (GEO), also to be published in 2007. In particular, accurate and up-to-date information on Land Cover/Land Use (LC/LU), across the vast Eurasian region, would be a significant addition to these and other international reporting processes. The RS-derived data could be used to calibrate - or complement - ground based data, and would offset the need to collect extensive amounts of additional field data to update the indicators in time. In future initiatives, the results of the present proposal could also serve as a baseline against which monitoring the Eurasian territories and measuring environmental change.

In this regard, the proposed Pilot Programme appears to be well in line with the GMES initiative. The outputs proposed here, for the Eurasian macro-region, could therefore find natural integration into the European operational systems that shall monitor natural processes and impact of anthropogenic activities at the global scale.

Finally, noting that the EC/ESA Green Paper on European Space Policy [5] identifies [5, page 22] that "Earth observation... enables more effective management of natural resources and stricter control of environmental parameters and regulations," the proposed Pilot Programme should be of concern for the EC/ESA Joint Task Force (JTF) in order to:

- consider the above initiative as a pilot activity within the GMES framework;
- monitor its results to identify future actions that could build on the experiences gained in the practical application of EO data for environmental reporting; and
- consider the challenges and constraints encountered during the Programme's implementation, as a means for identifying future actions that could address these obstacles and enable the success of similar future actions.

Implementation of the above could stimulate demand for European RS data, support the EC objective to achieve sustainable development, contribute to the development of the European space sector, and support the realization of GMES objectives including "coherent solutions operational by 2008."

2.3 Work Plan, main Work Packages (WP)

2.3.1 WP 1 Scoping/Start-up Phase

Time frame: *March – November 2004*

The activities under the WP 1 would include:

- (a) To determine choice of EEA land/surface water indicators (CLC based);
- (b) To identify contacts, technical capacities; collect baseline data sets, evaluate and identify and fill gaps;
- (c) To develop methodology for populating the basic GIS system (indicator atlases);
- (d) To determine specific geo-focus/target region for pilot demonstration.

2.3.2 WP 2 Capacity Building

Time frame: *January – November 2005*

The activities under the WP 2 would include:

- (a) To introduce & demonstrate data integration methodology via workshops;
- (b) To populate GIS with RS data;

- (c) To disburse and install equipment;
- (d) To refine data integration methodology.

2.3.3 WP 3 Application Demonstration

Time frame: July 2005 – July 2006

The activities under the WP 3 would include:

- (a) To collect updated RS derived data. An assessment (and procurement) of the RS data currently available, to satisfy the information requirements should be performed, involving once again the end-users network;
- (b) Contact points' process and further populate the GIS;
- (c) To derive useful information ('interpretation') for environmental reporting;
- (d) Production of the foreseen indicator atlases will be conducted by each partner in the participating EECCA countries.
- (e) Training on the use of guidelines and a handbook (different trainings for experts from EECCA countries: advanced group & beginners).
- (f) A review of existing indicators to be used, with feedback from end-users originated by the opportunity awareness campaign;

2.3.4 WP 4 Publishing/Results Dissemination

Time frame: December 2006 – March 2007

The activities under the WP 4 would include:

- (a) To finalise methodology handbook/guidelines & publish/distribute;
- (b) To demonstrate results within a wrap-up workshop and identify future needs;
- (c) To deliver input to the Fourth 'Beograd' Assessment and GEO 4

List of Acronyms

ADE	Application Demonstration Exercise
CBA	Capacity Building Activities
EC	European Commission
EEA	European Environment Agency
EECCA	Eastern Europe, Caucasus and Central Asia
ESA	European Space Agency
EU	European Union
JRC	Joint Research Centre
OAC	Opportunity Awareness Campaign
REC CEE	Regional Environmental Center for Central and Eastern Europe
RS	Remote Sensing
UNECE	United Nations, Economic Commission for Europe
UNEP	United Nations Environment Program

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