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Desicion Support System For Natural Hazards

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The problems that do not permit environmental data to be turned to good advantage can be outlined as follows. Damage caused by emergencies is attributable not so much to the lack of significant technological advancement as to the low level of decision makers' (DMs) awareness and inadequate account of the available information. In most cases DMs use information by intuition or on the basis of their own experience. Totally identical conditions of the environment recur very rarely. As a result the knowledge gained by DMs in the course of their activities tends to disappear after a while and cannot be used when identical environmental conditions are experienced again. Training of DMs to take due account of environmental conditions requires considerable resources. Dependence of the economy performance on the environment has not been studied adequately. Due to the large amount of information DMs can not respond to the continuous changes in the environmental conditions in a timely fashion. Sometimes information is not properly recorded, sometimes it is not delivered, and often it is not used properly or just ignored. Forms of information delivery are far from being perfect, information comes from various sources. It takes considerable time to deliver information. Sometimes delivery time is too long for DMs. Not all steps of information processing are automated. DM does not always know how and when to use operational, forecasting and climatic information. There are no legal norms to bring DMs to responsibility for not using information or for not taking measures to prevent damage. Potential damage from underestimation of environmental conditions may be significant and therefore the cost of the inadequate use of information may also be high. Attempts to improve consideration of environmental conditions by increasing the amount and range of information can cause even more difficulties for DMs. A number of potential emergency situations are huge, but a number of recommendations should be reasonable.

To resolve the above problems or to make them less significant it is necessary to develop decision support systems (DSS). DMs need not tables with initial data, analytical, forecasting and climatic information, but messages containing warnings on critical value accidence, information on probability of hazards, information on potential losses, and information on hazardous impacts and recommendations on decision making.

DSS can do the following: take into account impacts on specific points and on the total area under consideration; allow for the effects of the environment on economic entities (objects) in any geographical region to be analyzed; distinguish impacts and changes caused both by different phenomena and by their combination; signal when objects are or can be in adverse environmental conditions, e.g. in the area affected by fog, storm, tropical cyclone or in the area where the probability of hazardous ice events is very high, etc.

The main component of DSS is a knowledge base based on the following concept: if we know environmental conditions it is possible to predict potential impacts on the economy; if we know impacts it is possible to give a set of recommendations on how to prevent (reduce) losses or how to use natural resources most efficiently. Decision making criteria are safety of people and property, reduction of losses, increase of profit, materials saving, etc.

Knowledge base is a set of rules formulated in a formalized way using if, that, else.

If "Water level in S.-Petersburg >150 cm" that "To give out warning information "Hazards for building on coastal river Neva is possible" and recommendations "The valuable goods carry out in second floor" else "To switch another rule".

To have a knowledge base in place it is necessary to: develop tools of identifying and getting knowledge from experts; arrange the information flow from available information systems (operational data, analyses, forecasts, climatic information) through the system of information resources integration; maintain knowledge bases up to date. The last step includes the following: development and maintenance of knowledge bases in the distributed environment; formalization and dissemination of knowledge and provision of access to knowledge; knowledge

coordination and consistency check; registration of users by setting personal user profiles; continuous check of coming data for critical value accidence with respect to specific economic object and specific technological processes typical for these objects; generation and delivery of messages to DMs.

Key DSS data processing and use operations are:

• collection and compilation of information on a specific object and relevant environmental conditions and the first notification when needed;

• processing and storage of information with various levels of aggregation;

• computer or man-computer assessment of an object and environmental conditions and prediction of possible expected changes;

• search for recommendations under various conditions of an object and the environment or under unfavorable tendencies;

• optimization of recommendations;

• making decision with a possibility to activate for analysis both data forming the basis of recommendation and rules being used;

• implementation of recommendations, assessment of implementation and documenting of all steps of the system operation.

DSS should actively employ various models such as those used for forecasting of hydrometeorological conditions, evaluation of environmental impacts on economic objects, optimization of recommendations, evaluation of damage and profit.

Significant contribution to decision support would be made by GIS in the form of a detailed layout of economic objects; local, regional and global maps of environmental conditions where potentially hazardous regions are marked; climate change analyses and projections.

In the future it is planned to adjust indicators, to identify vulnerability of the economy to natural hazards (intersection of economic centers and natural hazard risks), to develop tools to identify specific regions with complicated socio-technical environment exposed to natural hazards.

DSS makes it possible to: deliver initial, analytical, forecasting and climatic information at any moment, in any point, on any region and to any device; take into account all operational information and on its basis provide recommendations on decision making; optimize shirt-term and long-term planning; minimize damage and losses due to prompt and informed decisions.

Currently a static page showing examples of impacts and recommendations for various marine hazards is available at http://www.meteo.ru/nodc/project2/action.htm,http://www.meteo.ru/nodc/Product/recom.htm#m.

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