Topical Coastal Environmental Issues of Japan Sea

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Coastal areas are among the most developed places on Earth. This is where people extract mineral resources, catch fish, develop aquaculture, engage in recreational activities, launch construction projects, etc. Coastal areas became a sort of a geographic filter for big flows of energy and various substances. This is why it is necessary to organize the use of coastal resources in such way so it would not damage the natural environment and marine ecosystems.

About 80% of people on Earth live on the coast or within 100 km from the sea. Most of the biggest cities with population over 1 million are also on the coast. Most of the industry is there as well. Because of this we observe many environmental conflicts in the system "man and environment."

The most prominent issues that are equally important for Japan Sea are oil pollution, litter, and ballast waters. Let's take a closer look at oil pollution.

The oil spills have a great impact on life in the sea and therefore the quality of coastal-marine resources. The level of marine transportation in the Sea of Japan is very high as you can see on this slide. It increases the risk of accidents and the possibility of oil pollution. We can bring many examples of the impacts of oil on marine environment. The transboundary pollution is among particularly important issues. We need different information in order to prevent or clean up spills and establish the whole environmental safety system. The environmental monitoring data play an important role in making efficient decisions. GIS mapping methods make it possible to interpret the monitoring data and use it for decision making. The results of our research show that maps allow specialists in different areas or even speaking different languages easily understand each other.

For instance, we developed a GIS system for prevention of accidents and taking response measures in oil spill risk areas. Such system considers the sensitivity of environment to oil pollution, which allows managing the situation and making efficient decisions. The picture 1 shows part of such map with main zones of marine biota

concentration and levels of vulnerability of the coast to oil pollution.

The picture 2 shows part of the system that we developed. The decisions are made based on modeling the spill behavior. Then the development of the situation is predicted depending on the set parameters and it is possible to assess the damage resulting from the spill.

The core of the informational-analytic system are the maps of sensitivity of the coast to oil pollution (fig. 3). The base maps show physical geographic features and other themes. These data provide the uniformity of information. The success of response measures depends on the features of the environment. The indices of coastal sensitivity to oil pollution is an important parameter that influences the decision making procedure. Such indices are the main criteria that reflect the relationships between the structure of the coast and processes that occur there if the oil comes in. The indices allow determining the speed of natural restoration of the coast and hence assessing the potential damage. We use indices recommended by the International Maritime Organization. For instance the index 8 unites closed beaches of different rock composition because there in hydrodynamic shade the transformation of oil is very slow. The speed of natural restoration is over 10 years. The smallest index means the least

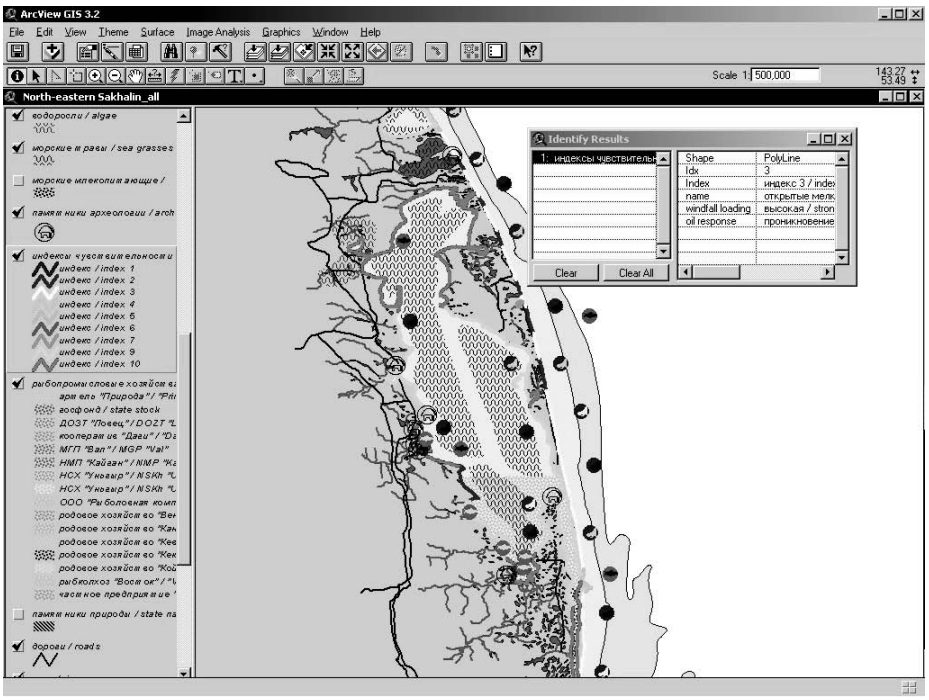

Fig. 1. North-east Sakhalin coast sensitivity map (fragment)

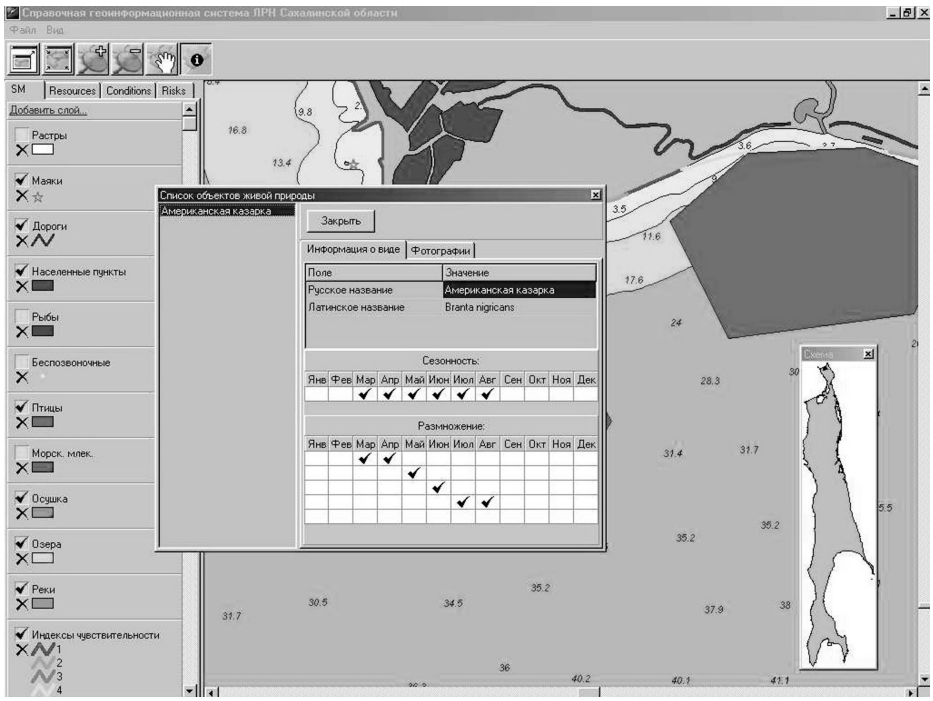

Fig.2. Decision making informational system (fragment)

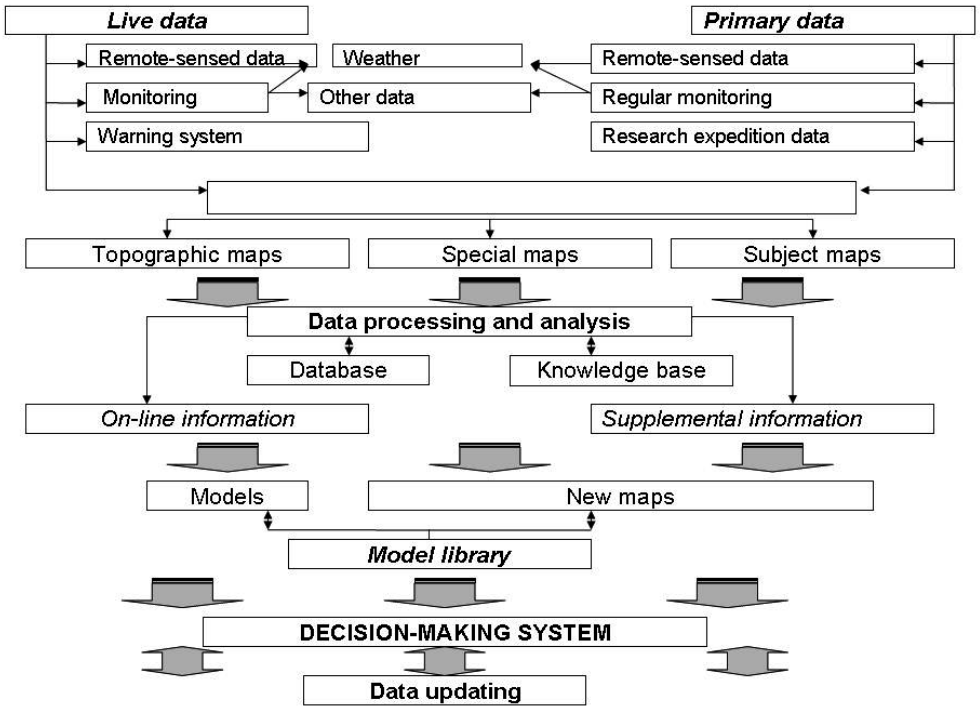

Fig. 3. Principle of information processing

sensitive coast and the biggest index corresponds to the most sensitive coast. In our research we assessed the sensitivity of almost all coast of the Russian Far East (fig. 4).

As we know from many existing examples the main damage from oil pollution is imposed on living organisms. That is why the choice of the spill response strategy requires information of the sensitivity of biota to oil pollution. The sensitivity of biologic communities differs by season. Taking this parameter into account along with the coastal sensitivity allows minimizing the damage, making quick decisions, and selecting priority areas.

The table 1 shows part of the matrix of the assessment of the sensitivity of biota to oil pollution and criteria that determine weights of the sensitivities of the main representatives of flora and fauna.

Different technologies are used as response measures for oil spills. For choosing the most appropriate technology we suggest to use the matrix as it allows selecting a combination of optimal response measures based on local conditions (parameters of oil and environment).

This is how the process of operational modeling works (fig 5). After receiving the

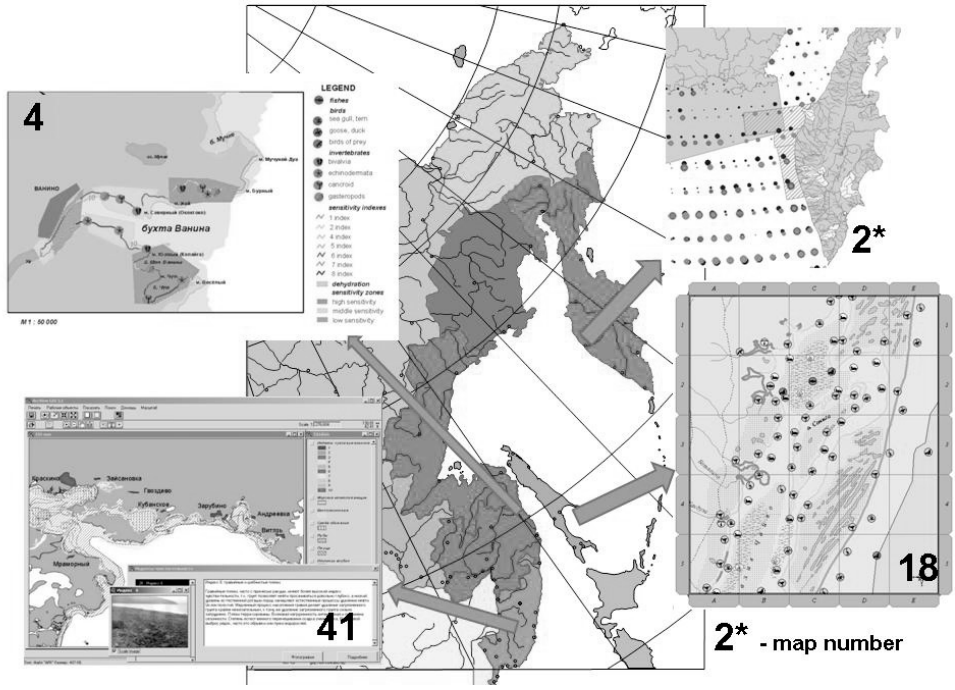

Fig. 4. Sensitivity maps for Russian Far East

Table 1 Matrix of the assessment of the sensitivity of biota to oil pollution (fragment)

Criterion	Object	Description	Index
Compensability	Recoverable	No ecosystem reconstruction	1
	Conditionally recoverable	Reversible damage	2
	Irretrievable	Irretrievable damage	3
Value	Background	Typical object	0
	Sold commercially	Mass catch	1
	Containing valuables Sold commercially	Important economical part	2
	Local secured	The local Red book	3
	Regional secured	The national Red book	4
	International secured	The international Red book	5
Vulnerability	Low vulnerability	Live ability isn't connected with coast	1
	Middle vulnerability	Incidental occurrence at coast	2
	High vulnerability	Direct connection with coast	3

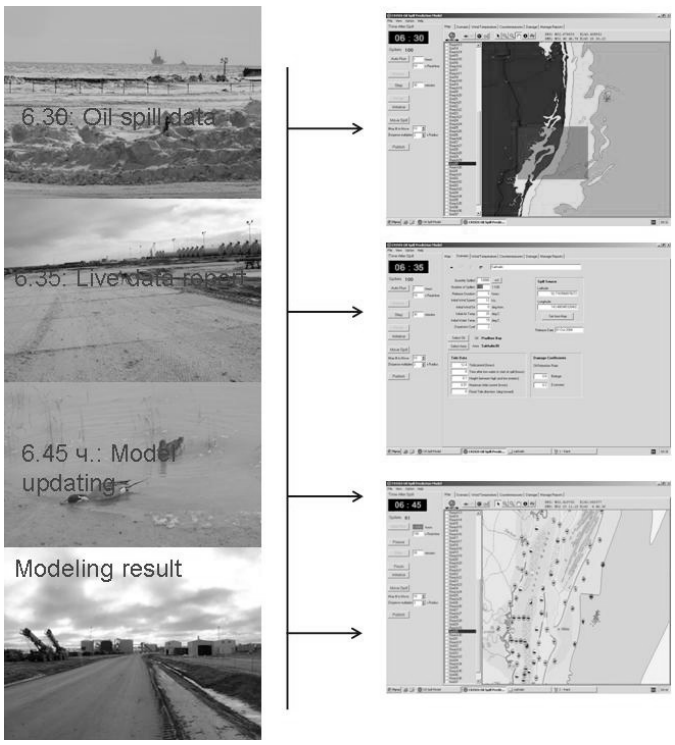

Fig. 5. The operational modeling process

information about a spill the area of potential risk is selected on the map. Then we fill out the inquiry form based on existing data. Then the modeling restarts and shows most sensitive areas and suggests response measures according to the prediction of the oil spill movement.

It is not possible to predict precisely the place, time, and scale of oil spills. So we could use different scenarios that we put into the system. Usually we consider the typical and worst weather conditions in main seasons. The base scenarios could be modified with additional inputs. As the result of such operational modeling we can manage the situation more efficiently.

To sum up our GIS mapping system based on the sensitivity of the coastal areas to oil pollution is used for planning, obtaining reference data, and making predictions and recommendations. The available algorithms allow setting priorities and form a complex environmental safety system. Doing a joint research should make it possible to increase the level of environmental safety.

Keywords Coastal Environment Marine Ecosystems Transboundary Pollution
GIS Monitoring Natural Restoration

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