

An adaptive cartographic visualization for support of the crisis management

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Abstract

Adaptive cartography is one of the most important directions of the contemporary cartography research. A crisis management belongs to the typical areas of adaptive cartography usage. This text is focused on basic definition of the adaptive cartography and consequences of such definitions for crisis management practice. An overview of the research topics recently created research group for cartographic visualization support in crisis management is also presented.

1. Adaptive cartography

One of important direction of contemporary cartography is to be tailored on user demands. GI technologies allow real-time dynamic change of symbolic and map content (with some constraints...). In contrary to analogue map where production time leads to universality and maximal information saturation nowadays we can make maps for unique user, unique situation with proper amount information. Basically adaptive cartography offers to user more or less the same functionality as a GIS map interface. Difference is in automated processing of cartographic visualization. In case of GIS is cartographic visualization user-driven – user, according to purpose, selects map content, rarely makes generalization and attaches appropriate symbols. Consequent visualization is usually for his use only (hopefully). Idea behind adaptive cartography is to automatically make proper visualization of geodata according to situation, purpose and user's background. Adaptive maps are still supposed to be maps, i.e. correct, well readable, visual medium for spatial information transmission. All map modification processes are incorporated in electronic map logic. Users can affect adaptive map just indirectly by a context.

The context is composition of characteristics describing:

- *Who will read the map?* – Information about map reading skills and abilities of the user, his/her visual preferences, level of knowledge and education. Such information is a base for so called **profile**.
- *Why is map made?* – Information about the task, spatial extends of the area of interest and information about map feature hierarchy according to the task.
- *Where we use the map?* – Information about place, time, orientation and environmental conditions of the map perception (for example light condition).
- *What is a map device?* – Set of constrains influenced by display size and parameters, transfer rate from geodata source and software abilities.

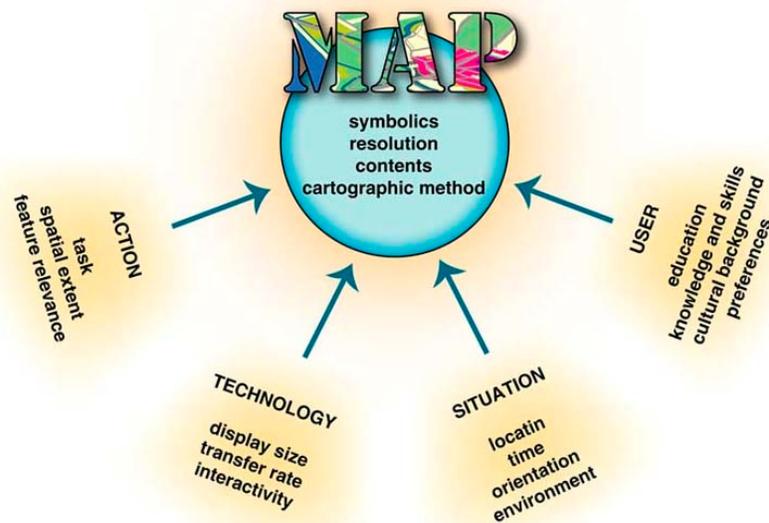


Fig.1.: Context in adaptive cartography

Purpose of the context handling is to decrease time necessary for decision making. In case of spatial oriented issues is map natural medium for information storage and exchange. Efficiency of this information processing strongly depends on map use skills and also on ontological homogeneity of users' point of view. In real situation is necessary to count with high heterogeneity of users collaborating on spatial related tasks. Consequently special map representation for every user is needed. Because is out of a technological possibility to create individual map for every person in any situation, more feasible is to create several user groups. Also situations are divided into certain amount of scenarios, covering the most common context combination.

The reaction on the context change is change of the map content. Changes are related to the particular context attributes and are possible distinguish following cases:

- *Change of symbolism* – the most simple and the most common method of adaptation. The change is related to display capabilities, environmental conditions and user background or preferences. Typical implementation approach is creating symbols thesauri covering various user groups and devices.
- *Cartographic generalization* – quite complicated and time consuming issue. Generalization processes react on a change of purpose, changes of features significance, changes of the spatial extent and partially also on data transmission rate. Usually amount of the features and features classes is reduced and also feature representation is simplified.
- *Change of cartographic method* – is related to the user background or to the purpose of the map. For users, unskilled in map reading, is profitable usage of less abstract and easier to interpretable methods.



Fig.2.: Various point representation of fire on Crisis Management maps (based on Dymon, 2003)

In many cases is impossible to separate all three types of changes. Necessary change is usually combination of all methods. For example if there is requirement for presentation of highly specialized theme to public is imperative to adjust all aspects – simplify or even radically change symbolism, reduce content and finally use unequivocal cartographic method.

2. Adaptive cartography for crisis management

Crisis management is typical case for the geo-collaboration of heterogeneous user groups. There is possible to define very different groups varying in roles, skills and knowledge. Every group is possible to describe by ontology, list of tasks, spatial extend of authority and place of operation.

Among these groups belong:

group name	map use skills	map use environment	education	ontology	tasks	spatial extent
Experts	high	desktop	high, specialized	theme specific	prediction models design	model dependent
Regional government	low	desktop	mixed, unspecialized	laic	global strategy	regional
Dispatching center	medium	desktop	middle, specialized	crisis management	control and coordination of operational units	regional
Operational units	medium	mobile	low/middle, specialized	crisis management	action	local
Local government	low	combined	mixed, unspecialized	laic	operational units support, communication with public	local

Specific issue is cross border collaboration during crisis, where different languages, cartographic manners and sometime different thematic ontologies of experts are involved. In these cases are necessary also language thesauri. Various topographic reference bases are a challenge to be solved too. In case of The Czech Republic it is even inner issue, because of historical reasons tied to differences between civil (used by government) / military (used by majority of experts and crisis operational units) topographic bases.

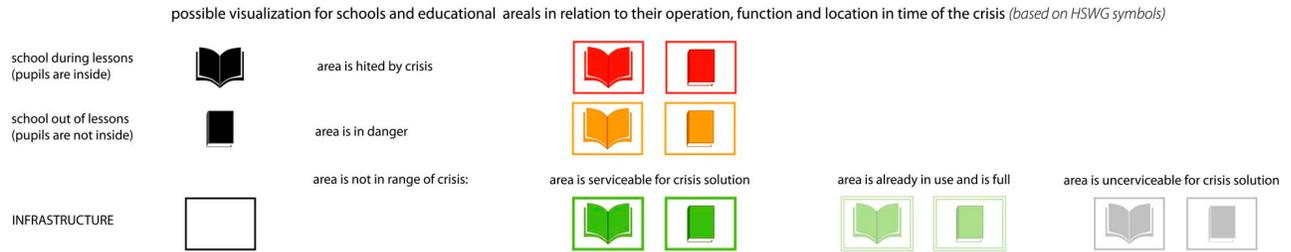


Fig.3.: An example of context based symbolism

3. Dynamic geovisualization for crisis management

For the support of the crisis management by “intelligent” maps was established research group based in Laboratory on Geoinformatics and Cartography at Masaryk University in Brno. Research group is composed form cartographers, geographers, mathematicians, psychologists and computer scientists. Implementation and evaluation of methods is provided in close collaboration with Crisis Management Centre of Southern Moravian region.

Research is divided to several main tasks, covering issues of dynamic adaptive visualization:

- *Integration geodata from various resources* – establishment of common reference base and automated transformation of geodata location and granularity according to source reference base and scale.
- *Transformation of prediction models* – real-time transformation of model results to be more readable for non-specialist.
- *Automated generalization* – real-time reduction of map content complexity according to scale, purpose and territory characteristics. Approaches of multi-resolution database and simple just-in-time generalization are combined.
- *Crisis management participant’s ontology description* – point of view of different user groups is described and symbolism thesauri are created.
- *Symbol design* – according to device characteristic, cognitive research of perception in stress situations and existing standards and customs new symbol sets are proposed and evaluated.
- *Cartographic support for change recognition* – implementation of the visualization techniques, which can handle dynamics of the situation (change of object, its importance, movement etc.).

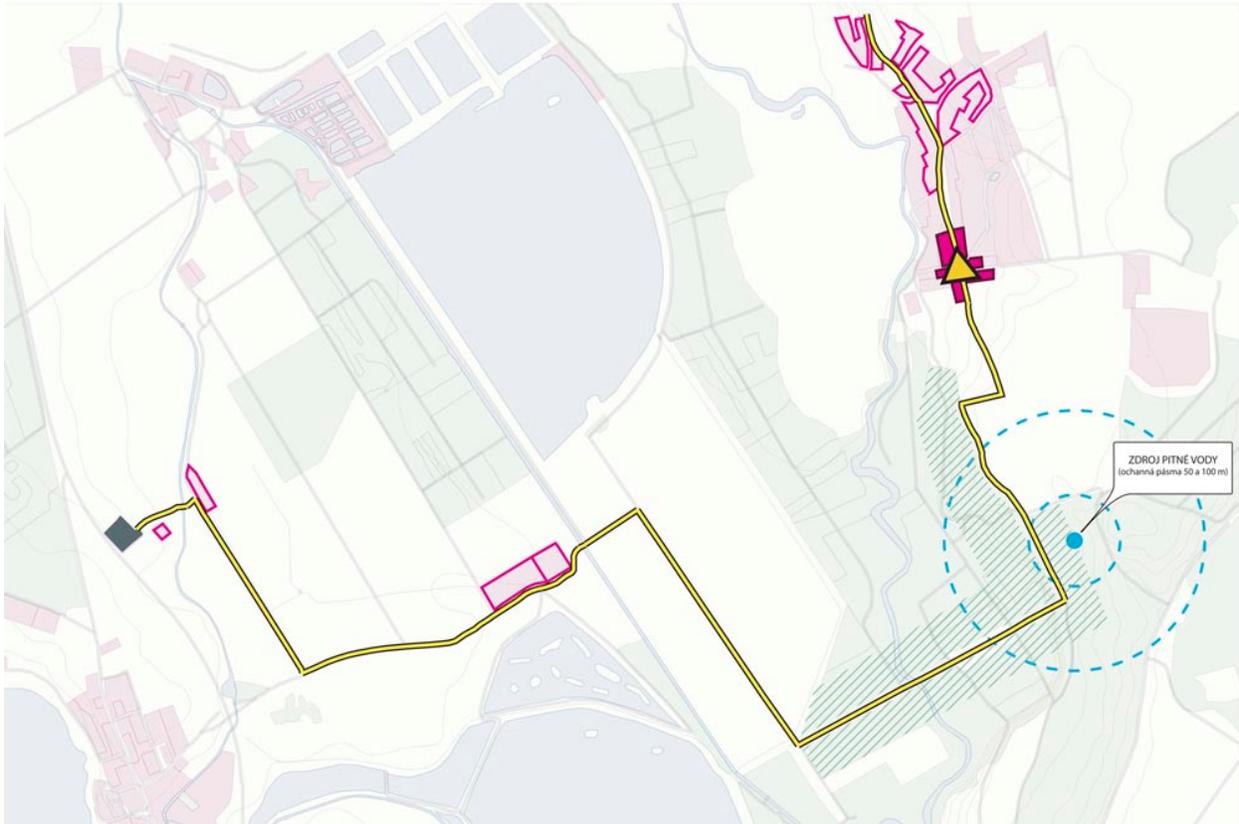


Fig.4.: Example of dynamic visualization of the moving object with hazardous material

Duration of the project is seven years. In the actual stage is research focused on issues related to crisis situation related to hydrosphere and on hazardous material transport. Roles of the participant are defined and their ontologies are processed. Whereas in hazardous material transport are in the cartographic frame solved issues of change recognition, in case of hydrosphere (such as floods) we are focused on experts thematic maps transformation to simplified laic version maps.

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