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STRUCTURE OF THE DATA BASE FOR OPERATIVE THEMATIC CARTOGRAPHY

Commission IY

Use of satellite information in the cartography is especially effective in a field of so called "operative thematic cartography".

Need in operative thematic maps arises in cases when the explored processes related to the surface of the Earth lead to remarkable changes of their parameters whithin hours/days. Examples may comprise: ice and hydrometeorological situation in Arctic and Antarctic seas, condition of plant cover in agricultural areas, distribution of water temperature in the ocean, change of snow cover in the mountains e.t.c.

In those cases when it is required to obtain even higher operativeness in presenting explored processes obviously we must discuss not the cartography itself, but direct analysis of photographic pictures of explored processes (and it is natural, that the requirements to the depth of analysis complexity and result representation must be considerably reduced).

Another prerequisite of operative thematic cartography development (besides the satellite data of remote measurements) is the use of contemporary computers for digitizing,input, storage, interactive editing, performing of thematic calculations and registering of operative thematic maps.

Operative thematic cartography has a number of peculiarities which define special approaches to the development of automated technology of operative thematic cartography.

The requirements complicating the development include following:

Operativeness of cartography (including simplicity and convenience of input and editing of thematic maps.

Necessity of simultaneous use of different sources of information (including the interactive editing of the results from processing of several satellite pictures, thematic map of previous cycle, auxiliary maps e.t.c, which had been reduced to one cartographic projection.

Necessity to perform a calculation and construction of operative forecasting thematic maps of explored processes (including calculations of forecasts with the use of statistical and dynamical models).

Necessity to store a large number of operative thematic maps in the data base sor statistical analysis and statistical forecasting.

Requirements to accuracy and scaling which do not allow to limit the map by size of the screen.

Adaptability to thematic specificity of maps (as well as to different and new cartographic elements - symbols, lines, shadings).

At the same time a number of simplifying circumstances, inherent to operative thematic cartography allow to use them for increasing the effectiveness of automated technology.

These circumstances include:

New (next) thematic map is, as arule, topologically homoemorphous (except certain places) to thematic map of

previous cycle (though the bounds of thematic areas mostly will be changed, the bounds, as they are, and topology of areas in majority remain unchanged during adequate cycle of thematic map updating).

Operative thematic maps designed for definition of main characteristics of explored processes, as a rule, do not contain too much cartographic elements, that is , they are not too "particoloured".

When performing digitizing, interactive editing and registration of operative thematic maps it is quite enough to use simple depicting facilities for their representation (symbols, lines, shadings, inscriptions).

The most important element in development of automated system for operative thematic cartography is designing of the cartographic data base.

The outline (structural) representation of cartographic information in the data base most of all corresponds to the peculiarities of operative thematic cartography shown above.

The cartographic relative data base is configured as a complex of mutualy related files/tables of cartographic elements (certificates, lines, outlines, areas, symbols, inscriptions). Besides that, catalogues of cartographic element image descriptions (symbols with parameters, lines, shadings), codificators of thematic characteristics etc are organized and supported individualy.

These catalogues allow to input new cartographic elements into the system by means of special language of graphic representation which describes a rather wide class of symbols, lines, shadings (during interactive editing of the map it is

quite enough to input a code of required cartographic element with corresponding thematic parameters).

The outline (structural) representation of cartographic information has in this case (operative thematic cartography) considerable advantages to be compared with a raster representation:

- Considerable savings of computer external and core memory space.

- Convenience of "multilayer" thematic map, as well as multiparameter description of thematic area, required for performing thematic calculations and forecasts.

- Constructive (explicit) definition of areas which permit , when it is necessary, easy transfer to a raster representation (colouring of thematic areas).

- Possibility of fast execution of the cartographic operations (cartographic algebra), as well as auxiliary operations (conversions of projections etc).

- Natural character of outline representation for registration of thematic maps on plotter.

The main problem in this case - forming of outline (structural) representation of thematic map on the basis of various input data including scanner (raster) satellite information- is successfully solved by means of interactive editing of thematic map with their visualization (and processed pictures) on colour semitone raster display unit.

In operative thematic cartography the most complex cartographic element is a thematic area. The problem is how to match requirements to the convenience and operativeness of area editing with constructive manner of their definition

in the cartographic data base.

Let us consider the geometric part of this problem in detail. The above relative topological stability of operative thematic ,maps (at least within the scope of one updating cycle) comprises the basis of considered conception for representing of thematic areas in the data base.

It is naturally to consider a line as the main cartographic element (this can be one or another thematic isoline, bound of thematic area, trajectory of some object movement etc). This as well can be a stable, steady line - the board of a country, coast line, river, edje of precipice, railways etc. Though such lines are frequently marked on blank maps, they must be entered into the data base, since they can be selected as the thematic area bounds).

As a rule, each line has a certain meaning and is entered into the cartographic data base as an independent object which is represented by sequence of break points (during registration on plotter, when it is necessary, the line can be smoothed).

The thematic areas comprise actually the areas, limited by outlines made up of such line sections (the outline is understood as the bound of a singlerelated area and the area is understood as multirelated region, limited by external outline with internal "put out" areas limited by respective outlines).

Thus, the area is geometrically defined by a set of outlines which, as a rule, is not very big (the first outline is external one, the rest of them are internal "put out" outlines).

So the problem is now presented as definition of outlines composed of sections of different lines entered earlier and added/modified in the process of map interactive editing. The idea is to reject common requirement to use rigid fixation of intersection points of those lines which sections made up the outline (besides that, this requirement leads to the necessity of generating a new break point in the old steady line (for example, coastline), that is to modify the line which does not require modification only because a thematic area bound had joined it in a new place).

The outline is presented in the data bse (in general features) as a closed sequence of corteges:

- Line code.
- Direction of line section.
- Type of intersection of a line section with next line.

(there are four types:

end-begining

end-middle

middle-begining

middle-middle).

- Number of intersection of a line section with next line (for intersection of fourth type).

Actually, the term "intersection" in relation to first three types is to be understood conditionally (the exact correct intersection (joining) in accordance with specified type is not required).

Thus, all nodes of line section connections which compose the outline are reffered to as "floating" nodes. In this case even if all lines are chahged after updating of the map, but topology of the map remains unchanged, that is line sections which compose respective outlines remain as they are (though in a changed form), representation of outlines and areas will remain totally unchanged and so the most difficult procedure of interactive editing - marking out of thematic areas will be reduced to simple checking of modified areas.

Certainly, in practice some areas will require an additional editing because of the local homoemorphous disturbances.

It should be noted that operator who carries out interactive editing of map does not need to know the described structure of cartographic data base. He manipulates with more simple and natural features and all required conversions of data are performed by computer. The conversion of data into required format of the cartographic database is not a very difficult task and it is executed in the process of interactive ediding.

The operation of explicit outline calculation with the use of given line intersection types is not a complicated task for a computer as well.