Software Tools to Handle the Layers in a Specialized GIS analyzing Greenhouse Gas Emissions

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Abstract - This article presents an approach to the development of architecture of the module "Slicing the Layers of Greenhouse Gas Inventory" of the geographic information system. It provides rationale for using the module, describes its architecture and key functions, and determines software requirements.

Key words – information system, software product, greenhouse gas emissions, algorithm, maps, module.

I. Introduction

Climate change is one of the most critical environmental issues. [2]. Consumption of different kinds of energy is constantly growing, which leads to the increase of greenhouse gas emissions into the atmosphere. The authorities value the approaches that provide space inventories (cadasters) of greenhouse gases on the regional level. Today's software market includes a number of software products (MapInfo, ArcGis, etc), which allow performing a wide range of operations related to the geographic analysis. However, they are not adapted to the state of the practice of greenhouse gases inventory. In addition, this software is paid.

This research presents the architecture of a specialized module used in the geographic information system analyzing greenhouse gas emissions [1,3] in different economic sectors. It aims to extend the current geographic information system architecture by adding a module for slicing the layers. Input data of the geographic information system is digital maps of the analyzed region in vector and bitmap formats.

II. Module Architecture

Development of the layer-slicing module is relevant considering that digital maps divided into surface elements of the size of n km * n km are used to provide a detailed image of emissions distribution within the limits of large population centers or urbanized territories.

Taking an inventory of greenhouse gases, one needs to use several digital maps of one population center to cover different economic sectors. The layer-slicing module allows working with several superimposed layers of a digital map. The process of slicing consists of two stages:

1) superimposing a grid over all the layers
2) slicing the layers.

Fig. 1 shows the first stage of the module.

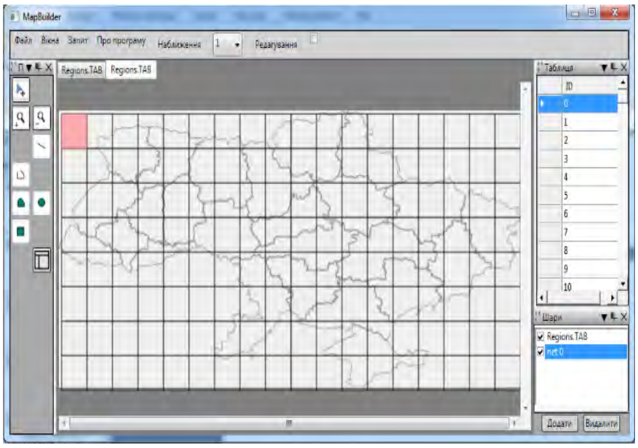

Fig. 1. Example of superimposing a grid on the layers

The objects of the region-type or any closed graphics objects are sliced with the help of graphic means of .Net Geometry library using Geometry class. It includes the methods necessary to slice the objects.

The research uses the following main methods of Geometry class:

FillContains(Geometry) - indicates whether one geometry completely contains another one;

FillContains(Point) - indicates whether the geometry contains the specified point;

GeometryCombine(Geom1,Geom2,mode, transform) - combines the two geometries using the specified combine mode (intersection is used for slicing).

To slice zigzag lines, we use an algorithm based on pair combination of zigzag line vertices with the search for pair intersection of these lines.

The general algorithm to slice zigzag lines is as follows:

1) the first point is verified (if the point is in the slicing sector, this point is considered the first point of intersection with the purpose of simplifying the algorithm);
2) two neighboring vertices are combined into a line;
3) search for the first intersection;
4) search for the next intersection and combination of all intermediate lines into a new zigzag line;
5) a new zigzag line is added to the resulting layer, with tabular data being copied;
6) nullification of the points of intersection and transition to step 2;
7) the last point is verified (in case of total inclusion into the slicing sector without the point of intersection).

Fig. 2 shows the diagram of slicing module activities.

For the layers including different types of geometric objects we use the module that selects the fully satisfactory slicing algorithm on the basis of metadata on the type of the slicing sector and the element over which this sector is superimposed.

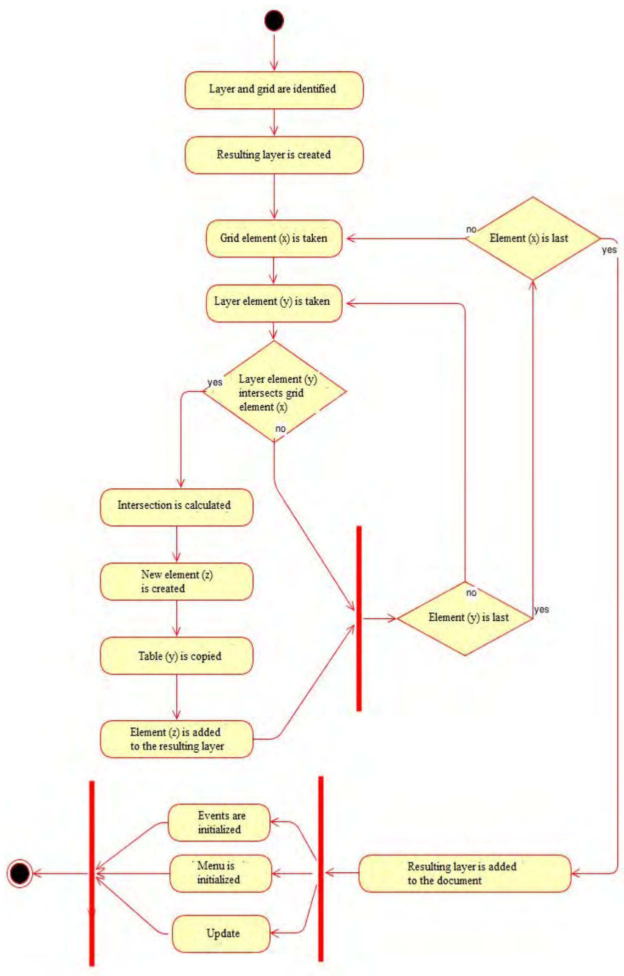

Fig. 2. Diagram of slicing module activities

III. Requirements and results

Basic requirements for the layers processed by the module:

- slicing is to be applied to the layers including closed regions, lines, zigzag lines, and points;
- while slicing large regions and lines, the information from the table attached to the current region is to be copied and attached to each of the regions created as the result of slicing, with the points copied along with the data attached to them;
- all layers in the working window located under the active grid are to be sliced.

Slicing will result in a new layer with all graphic objects included into the grid (Fig. 3 and Fig. 4).

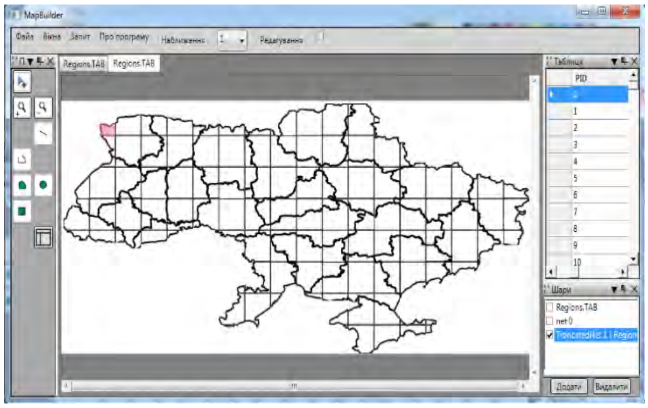

Fig. 3. Slicing of area objects

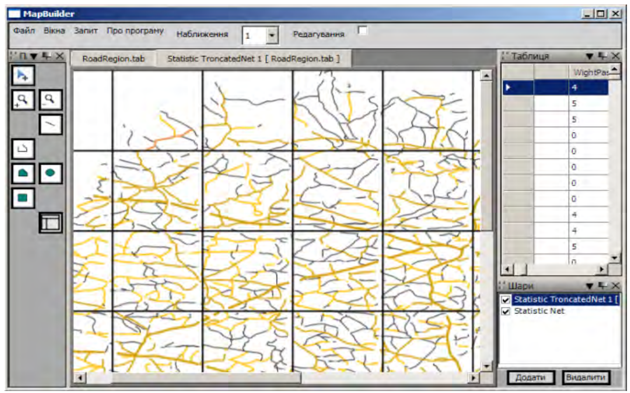

Fig. 4. Slicing of linear objects

Conclusions

While taking a space inventory of greenhouse gases, it is rational to use the specialized geographic information system which takes into complete account specific procedures of generating space cadasters of emissions. An important place in the geographic information system architecture belongs to the module for slicing the layers of digital maps which is used to disaggregate data on the results of economic activity. The article describes the algorithms on which the module is based, determines basic requirements for the processed layers, and shows an example of module in operation.

References

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