Fuzzy information in Geoinformatics

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When solving problems using geographic information systems (GIS) [2], [3] often there is a need to provide approximate or insufficiently reliable information about the map objects in the geographic information database.

Geospatial information arises mainly from the need to address geographical problems, many of which are of social, economic and environmental importance.

GIS combined with satellite remote sensing of the earth's surface are advanced technologies for managing large amounts of information related to geographical mapping, modelling and decision-making. Geoinformation technologies offer a wide range of functions, such as information search, display, processing, decision support.

Geographic concepts formalized and implemented in GIS reveal more complex geographic forms, models, and processes. These may include topological relationships of adjacency, connectivity, and intersection; concepts of simple and complex geographic features, and so on unfortunately, geographic data are often analyzed and associated with significant uncertainty. Uncertainty is present throughout the process of geographic abstraction, from data acquisition to data use.

Heterogeneous data of different origin and accuracy have some degree of uncertainty. Uncertainty can be considered as a measure of the difference between the data and the dimension that is assigned to it by an ordinary user. Therefore, there is a growing need for information with uncertainty based on GIS.

Geographic data recorded in a GIS is a representation of some phenomena. For example, it may not be possible to determine the true soil class if the soil class definitions themselves are mostly uncertain or inaccurate.

Consequently, the notion of "uncertainty" may be a more realistic view of geographical dimensions than the notion of "error".

Inaccuracies and uncertainties exist in many geographical applications, reflecting the inherent complexity and subjectivity of the geographical world. The use of the term "uncertainty" indicates some randomness of geographical information. In addition, uncertainty may be the result of a lack of information.

Fuzzy data on objects is usually caused by one or several reasons, including [4]:

- possible inaccuracy of information arising due to the error of sensors or due to inaccuracy or impossibility of measurement of object parameters. The presence of this type of fuzziness causes inaccuracy in setting variables in models, initial and boundary conditions;
- inaccuracy of parameters caused by characteristic features of related objects;
- uncertainty in the decision-making process due to the fact that the presence of clear (accurate) goals, models and their corresponding decisions does not accurately describe the system of objects under consideration and leads to sufficiently large errors in decision-making due to ignoring some important factors;
- blurring due to environmental factors.

It should be noted that the formulation of problems in fuzzy form significantly reduces the possibility of obtaining incompatible solutions in the calculation and optimization.

Build models in the framework of the fuzzy approach enables to compare model. There is a possibility of formalization of inaccurate knowledge about the subject area, entering into the model information about the incompleteness of information.

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