When 3D Models of Real Environment become 3D Maps?

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Abstract. The report considers the cartographical elements applied in 3D mapping which help a 3D model to become a 3D map: user requirements, map contents, symbol system, accuracy, scale, projections and generalization, different levels of details. The new cartographical elements are added to improve the 3D maps: virtual camera, shades, lights and animation. Such approach will help map makers to represent geo-localization of the represented objects, measurements of the cartographic model and cartographic symbolization for correct information to the users.

1. Introduction
Cartography is one of the most ancient and in the same time one of the most modern science. The new three-dimensional (3D) technologies and the application of modern techniques give us evidences for development of cartography. On this way the modern cartography will supply Digital Earth (DE) ideas with the most suitable and understandable visualization of the real word. DE with its global dimension and multiple applications and themes has a strong technological component and provides a flexible framework to adapt to evolving technologies [3].

The research and development into 3D maps and 3D environment representations is challenging for every company attempting to distribute geospatial information to users in the most attractive way. The closest and right way to achieve this aim is the use of cartographical principles of representations or to make a 3D model as a 3D map.

2. Users
The major advantage in 3D cartographic modelling is that once created 3D model / map can be used for different purposes. It can be considered as database and source for creation of various applications with different functionalities used in different areas of interest. Now 3D highly accurate maps are a helpful tool for a wide range of industrial applications, such as construction, surveying, urban planning, and land management [5]. We can find users also in the field of education, design and advertisement, disaster management, city planning and architecture, telecommunications, cadaster, architecture, tourism, transport and many others.

3. Definition
Many authors speak about 3D maps and give different definitions [1]: Jenny H. M. speaks about 3D maps as “commonly known as landscape panoramas or bird’s-eye views” [2]. Artimo K. defines 3D map as combination of digital cartographic data and methods for representation [4] and Goralski uses the term 3D map as a synonym for interactive 3D map [6].
A 3D map can be determined as a mathematically defined, three-dimensional representation of the Earth surface or another celestial body, objects and phenomena in nature and society. Represented objects and phenomena are classified, designed and visualized under particular purpose and cartographical rules.

4. Content of 3D map
The concrete content of the 3D map is designed after the definition and classification of objects and phenomena that will be included. It could be subdivided into three themes [7]:

- **Main content** - large topographic or landscape objects such as relief bodies, roads, buildings etc. Most designed 3D maps, presented by different companies in the world, represent it.
- **Secondary content**, carrying the basic information. For example, in 3D urban maps – objects, represented by symbols – traffic signs, facilities, transport elements, information signs, trees, etc.
- **Additional content**, providing the quality and quantity information about objects, often created as a textual database, regarding each of designed objects or the map as a whole.

5. 3D model and 3D map
Every map consists 3D geometry, topographic information and photo-realistic texturing, 3D symbols, which contain quantitative and qualitative information about the objects, north direction and coordinate datum, scale, level of details, generalization, different levels of details, accuracy, toponyms, legend and title. New cartographic elements could be added to the 3D map: virtual camera, shades, lights and animation which will help map makers to make the 3D map more interactive and understandable for users. Including all these cartographical elements to the 3D model of real environment, will make it a 3D map.

6. Conclusions
This research shows that cartographic science with the latest modern technologies and appropriate visualization will find its place in the large aspects of tasks of Digital Earth, early warning and disaster management, climate changes visualization, touristic presentations, geo-science development. The next task is connected to find more applications and reduce the time and all machine and human sources for 3D map creation and visualization.

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