Digital Earth as a 'Miracle Cure' for Sustainable Development in the Era of Globalization

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The article explains that the classic principle of mapping is incompatible with the requirements of globalization and sustainable development for reasons of principle. Instead, Digital Earth concept could be considered as a new scientific paradigm that qualitatively empower classical cartography and provide reasonable quality of data representation for assuring sustainable development in the era of globalization.

Introduction

Providing sustainable development in the context of globalization is a challenge for cartography, because classical cartographic approach, implemented in maps and GIS, irreversibly dissociates Earth into the set of incompatible replicas of different scales, projections, thematic areas, etc. (Eremchenko et al. 2015). Globalization defined as a summa of 'all those processes by which the peoples of the world are incorporated into a single world society' (Albrow and King 1990), and incompatibility of different replicas of globally integrated situation leads to misinterpreting of data and incorrect decision-making. This definition emphasizes multiscale aspect of the term, because decision-making in the globalization context critically depends on the ability for seamless processing of data of different scales (Fig. 1). Therefore alternative approach for correct representation of global datasets is highly demanded.

On the other hand, sustainable development emphasize interdisciplinary approach. It requires seamless integration of heterogeneous datasets with different internal structures. Both requirements are the challenge for cartography, because combining of data of different scales directly contradicts generalization principle of cartography. Any type of generalization reduces information and deforms geographical features irreversibly.

Figure 1. Differences in representation of geospatial context for same area on maps of two different scales. Source: (Eremchenko et al. 2015)
Moreover, any map and GIS use specific mapping projection and, therefore, provides only specific direction of view, usually 'zenith-to-nadir' direction for large scale maps and plans (Fig. 2). This restriction is incompatible with interactive 3D-viewing of model, and decreasing quality of perception significantly as well as the number of parameters that could be measured of simultaneously. A lack of 3D-interactivity increasing the problem of correct interpretation of heterogeneous datasets significantly. Solving of aforementioned problems within classical mapping paradigm seems impossible, because source of these problems are basic rules of cartography method (Eremchenko et al. 2015). Thereby, the qualitative leap in the cartography methods is required.

Figure 2. (a - above) 3D-model of building in the geospatial context in the Google Earth. Source: http://vProtvino.ru; (b - below) the same building on the map. Source: Google Maps
Discussion

This quantum leap was provided by the concept of Digital Earth, that was implemented in the well-known Google Earth online service in 2005. Digital Earth usually defined as '...a global initiative to construct a comprehensive virtual representation of the planet... collaborative effort between Earth sciences, space sciences and information sciences to monitor and forecast natural and human phenomena' (ISDE 2006). In fact, Digital Earth is a new geospatial paradigm, based on new approach for processing and visualization of geospatial data.

The core of this paradigm is a concept that all data should be visualized within one common framework for all possible scales. Moreover, all data should be provided in a true three-dimensional representation that allows the user to interactively change the point of view and select most appropriate directions of viewing for the understanding of the real situation.

The concept of representation of all data withing one single common framework is well known as a theory of Situation Awareness. Theory of Situation Awareness is established in the 1990s (Endsley 1995), but it could not be implemented in classical cartography directly. The source of problem is a principle of cartography generalization that leads to shattering the single common framework into the set of replicas for different scales. It prevents direct relationships between different scales and separates the data of different scales. This process leads to misunderstanding between decision-making activities on different levels and threats to mismatch in the managing of global situation.

The contradiction between principle of cartography generalization and theory of Situational Awareness has been resolved in the new type of geospatial products — so called «Digital Earth» services (Google Earth, ERDAS TITAN, Cesium, etc.). It is generally believed that Digital Earth concept originated from speech of ex-vice-president of USA Al Gore (Al Gore, 1998). He discussed the emerging of global data repository with new set of properties, based on real geolocated data immersed in rich geospatial context. He explained Digital Earth as 'a multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data'.

Digital Earth is not a classical map and differs substantially from the classical mapping products like GIS (Turner 2006). Nevertheless, nature of Digital Earth still discussable and needs further study. Obviously, Digital Earth comes from classical cartography. In the same time, Digital Earth dramatically contradicts all basic ideas of cartography like generalization, projection, classification.

We propose to represent Digital Earth as a new scientific approach for processing geospatial information. This approach contradicts classical cartography approach, but is a result of its evolution towards free of aberrations modelling of Earth (Eremchenko et al. 2015). Therefore, we can discuss the impact of Digital Earth on the Sustainable Development concept.

Sustainable Development as a cultural paradigm requires accurate representation of
situation in all its diversity (UN, 2015). Fragmentation of the model of the real World on the basis of the scale, typical for cartography, became source of errors in decision-making. In some words, cartographic generalization contradicts of universal globalization of whole World in different aspects. Digital Earth as a new platform for integrating heterogeneous datasets provides possibility to eliminate these problems. In other words, Digital Earth may be considered as 'miracle cure' – paradigm that free of irremovable flaws of classical cartography and best possible framework for integration of different data for assuring sustainable development in the context of globalization.

**Results**

Therefore seems reasonable to discuss in future some new impacts of Digital Earth on the Sustainable Development concept and activities:

- possibilities for understanding new relationship between data of different scales;
- impact of direct, signless perception of real World on Sustainable Development;
- strengthening the decision-making support on different levels, from global to local;
- impact Digital Earth on scientific and multipurpose visualization;
- providing new scientific basis for better relationships between nations.

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**References**