

Space-time cube – a visualization tool for historical landscape changes

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Abstract

Mapping landscapes is the fundamental mission of cartography. Many well-established rules and guidelines are used to create meaningful visualizations, which are suitable and understandable for the desired users. In recent years, the time aspect in data representation is growing and it has become a demanding task to include time into the mapping. For smart and resilient cities, the spatiotemporal information about the cultural diversity is a key element in developing policies and practices for adapting to the global challenges. The main interest focuses therefore on tracking cultural heritage changes over the time and joining this information with additional metadata to gain new knowledge and insights. To achieve this goal, approaches from visual analytics seem to be suitable, in particular the space-time cube visualization. The cube's base is considered as the two-dimensional geographical space (like longitude and latitude) and the cube's height or vertical dimension is allocated as the time axis. The space-time cube has become a common practice for visualizing trajectories of moving objects, while further applications are developed in event detection and usability.

Within this contribution the results of a space-time visualization of historical landscape elements over the last centuries are presented. The approaches used were based on the cartographic research on visualizing space-time information and 3D information, such as city models. As a case study served the Royal Castle in Warsaw, registered in 1980 as a part of Warsaw's UNESCO World Heritage Site. Its different spatial elements constructed and destroyed during their eventful history, are visualized using a space-time cube. The footprints of the castle components, as well as the landscape structure around, were digitized, 3D modeled and annotated with monarchies and epochs in which they existed. During this process difficulties, such as historical sources in different scales and various representations needed to be overcome. This resulted into varying data accuracies, in particular within the georeferencing process. The data was visualized using up to date web technologies like HTML5 and JavaScript. To achieve a flexible and adaptable representation, the space-time cube visualization was implemented using the Cesium.js EarthViewer.

Domain experts from the Royal Castle in Warsaw positively valued this approach and expressed their interest for testing this representation of the castle in their future archeological research and development of marketing and exhibition strategies.